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In Europe several installations for transmitting power have adopted a high-tension direct-current system and use the earth as the return conductor. The problem is now presented to the officers of these companies to prevent outsiders from diverting the return current on its way back to the power-house and using it for their own purposes. The question involved is troublesome because any one who has authority to run an electric circuit may ground his line as often as he pleases, and if part of the current returning to the power-house finds it easier to travel along one of these lines, the constructor can not be blamed for this. Indeed, such a current might be very troublesome. On the other hand, if the owner of such a line can utilize a wandering current of this kind for charging a storage battery, say, or any other purpose, he can hardly be made to pay for this, because he is really doing the power company a favor in allowing part of its current to return over his line.

THE INSTITUTE MEETING.

With the meeting on Friday, September 25, the American Institute of Electrical Engineers began another busy year. Mr. Bion J. Arnold, the new president, took the reins and in a short address outlined his policy for the year. His plans are conservative and are intended to strengthen the Institute where it is now weakest and to maintain the interest in it and in its work. The remarkable increase in membership during the last year, due largely to an active canvass and the establishment of local sections, can not go on indefinitely, and to prevent retrogression the interest of the members in the local sections must not be allowed to lag.

Fewer Papers—More Discussion.

A much needed change in the conduct of the monthly meetings was referred to by the new president. More time is to be allowed to authors for presenting their papers, and to members for discussion. It has frequently been the case that so many papers were presented at one meeting that it was necessary for the author to present his paper in a greatly mutilated condition, and the result has been that few of the members present felt sufficiently familiar with the paper to discuss it intelligently. If more time is allowed for each paper there is no doubt that this will cause a more satisfactory discussion which will probably be the means of bringing to the Institute some valuable papers which would not otherwise be presented. To say the least, there is little satisfaction in preparing a paper carefully, with much expense of time and trouble, and then being forced by lack of time to read but the merest outline and to get little or no discussion. This policy should also raise the standard, as a whole, of papers presented to the Institute. Not to mince matters, a number of papers has been presented at Institute meetings which amounted to nothing more than an announcement of a new system of operation or a new class of apparatus. In papers of this kind the authors can give but little information of technical value, and the time of the Institute should not be taken up by them. The desired publicity can be secured by publication in the technical journals.

Standardization Committee.

Mr. Arnold also pleaded for assistance for the Institute standardization committee. The work of this committee is of great importance to the engineering profession, and members should feel bound to assist it in every way possible.

Papers on Electrohydraulics.

At the meeting three papers on matters connected with electrohydraulics were read. These were all by members from the far West. The authors themselves were not present and the

papers while of much interest drew out little discussion. This is to be regretted, as the paper by Messrs. Henry and Le Conte described a water power development of unusual interest.

ELECTRIC POWER FROM SPACE.

We have already commented upon the scheme of a western, shall we say, inventor, who says that he is able to draw electricity from the heavens above in unlimited quantities by means of a cable which he intends throwing up into the air.

The Scheme Endorsed.

This gentleman has recently been fortunate enough to have his plans examined by a western, shall we say, engineer, who, according to the daily press, is as enthusiastic as the originator of the idea. The former gentleman says that the latter purposes firing a cylinder vertically into the air above Pike's Peak. This cylinder will contain a magnet, a coil of strong copper wire and a time clock. When a height of two miles is reached the clock (if still in running order) will open the cylinder and the wire will begin falling and uncoiling as the magnet ascends. Finally the magnet will reach the ether and be held there, while the end of the coil of wire touches the earth.

A Possible Danger to Aeronauts.

The unimaginative may wonder why the wire should begin to fall, although the cylinder still keeps on its upward journey. The reason for this is, we are told, the presence of the magnet in the cylinder, which at that height, according to the originator of this scheme, is attracted strongly up into the ether. We would advise all aeronauts to take warning from this, if any magnetic material has been used in the construction of their machines, and never by any possibility rise two miles higher than Pike's Peak. They should remember, as stated in the prospectus of the inventor of this scheme, "from the earth's mass outward in every direction the mind of man contemplates persistent and insatiable distance, engulfing persistent and insatiable distances," lest they too be caught up by the mighty ether, that "unfathomable mystery" which as it "rolls along swallows up, in utter contempt of their magnitude, all these distances and passes on."

ARE DYNAMOS ILL TEMPERED?

Our esteemed contemporary, the *New York Times,* in commenting upon the very creditable performance of the generating plant of the Westchester Railway Company, at New Rochelle, N. Y., which continued to run during a fire that destroyed the power-house, says: "It really seemed to the imaginative as if the steam monsters were inspired by a heroic sense of duty and determined to stick to their posts, whatever might be done by their accustomed companions of flesh and blood. And stick they did for at least an hour and a half, until the fire had burned itself out and the engineers were able to make their way in and put an end to the queer display. What renders the episode the queerer is the well-known ill temper of dynamos, big and little, and their tendency to get more or less seriously out of order with small excuse, or none at all, that their attendants can discover."

The editor of the *New York Times* is evidently more familiar with the performance of electrical machinery through reports of accidents and breakdowns than from personal acquaintance with the machines at home. A dynamo is not ill tempered, though it naturally resents abuse, as does any thoroughbred. It requires a little attention, but very little, and when in charge of a man who understands it and sympathizes with it, it will do its work uncomplainingly and will stand more overwork than possibly any other class of machinery. As surmised above, the critic probably has little acquaintance with the behavior of dynamos when at work, a defect which will be corrected with time and the increasing use of electrical machinery.

Bulletin No. 3 of the United States census report on electric railways, just issued, shows that there are now 987 companies with a cost of construction of $2,167,634,077 and a capital stock of $1,315,572,690, as against, in 1890, 706 companies with a cost of construction of $389,357,289 and a capital stock of $289,058,163. In the year 1902 there were 5,871,957,830 passengers who traveled by street and electric railroads. During this time the cars traveled a distance of 1,805,397,802 miles.

ELECTRICITY IN GOLD EXTRACTION.

The gold with which we are most concerned for the moment is that which occurs in metallic form in quartz and quartziferous rocks accompanied only by the usual impurities such as pyrites, mispickel, etc., and alloyed with small quantities of silver, platinum, rhodium, etc. Copper and lead ores in which it is present are best left for discussion when dealing with these metals.

The Classification of Gold Ores.

The gold ores can be conveniently divided into two classes; (*a*) "free milling" and "alluvial" ores, and (*b*) "refractory" ores. These two classes sometimes overlap, as for instance when it becomes necessary to treat an ore by an amalgamation process and the tailings from this process by a subsequent chlorination or cyaniding process. The washing and amalgamation of free milling and alluvial ores are both very simple and inexpensive matters and in all probability the only difficulty that electricity can ever be made to overcome has already been successfully met by the now well-known "Molloy" process, in which the mercury is used as a cathode in dilute sodium sulphate. By this means a "film of hydrogen" is formed on the mercury, or perhaps it is more correct to say that a small quantity of sodium is deposited into the mercury and any oxidation of its surface consequently prevented, so that the prevention of "sickening" is successfully accomplished, the surface remaining bright and more easily catching up and retaining the fine gold. If the price of sodium metal falls sufficiently, it is possible that the more direct means of keeping the mercury bright by simply adding sodium to it will be again resorted to.

Processing Refractory Ores.

The case is somewhat different with regard to refractory ores or tailings which have refused to give up a large proportion of

their gold to the amalgamation plates. In the ordinary way two courses are open for the treatment of such materials, they must be chlorinated or cyanided. If they are chlorinated a somewhat complicated plant is required and the chlorine has itself to be made, which is a fairly expensive matter in districts where it is usually carried on. The ore is then leached and the resulting dilute solution of gold reduced by charcoal, sulphurous acid or ferrous sulphate, methods in themselves efficient and satisfactory, but somewhat cumbersome.

The Work of the Electrician.

A fair amount of attention has been given by the electrician to this part of the problem, but as a rule it has seemed as though the position of affairs had not been fully understood. As already pointed out, a really free milling ore is better left to the devices of the gold miner, and the electrician need only turn his attention to the refractory ores. In many electrolytic processes the ore is stirred up in a vat with a solution of common salt, carbon anodes are continually agitated in this mud and serve to liberate chlorine which immediately acts upon the gold and dissolves it. The cathode is a mercury one and is intended to catch all gold reduced into it from the chloride of gold solution in the vat. There is reason to believe that all gold which is naturally sufficiently finely divided, together with any float gold, is largely chlorinated and voltaically reduced. The bulk of mud being treated by such a method is, however, very large; there may be for instance several tons of mud being continuously stirred and electrolyzed for a long period of time in a complicated and expensive apparatus, involving large wear and tear and unavoidable loss of mercury. For this reason this method has not attained to much commercial importance.

The Cyanide Process.

The other way of dealing with a refractory ore is by the cyanide method, and here we have an almost perfect process in which electricity, although not essential, may be employed to make it even more perfect. The main disadvantages in the cyanide process are the excessive time required for the cyanide to dissolve the gold, the poisonous nature, and the high cost of the cyanide. The excessive length of time required for the dissolving is to some extent accounted for by the fact that air is required in the reaction, oxygen or some other oxidizing agent, in fact, seems to be necessary, and on a small scale it is possible to hasten the reaction by the use of some such oxidizing agent as bromine, but in practice it does not appear practicable. A very weak solution indeed is theoretically needed to dissolve the gold from an average ore, say 0.005 per cent or less, but in practice it is found necessary to use 0.05 per cent cyanide to dissolve the gold. Even this is too weak to enable the zinc afterward to precipitate the gold from the solution, so that it is found necessary to use five or even ten times as much cyanide for this reason. On the Rand a solution of about 0.3 per cent cyanide is generally used.

Electrical Reduction.

Attention has been directed to the electrical reduction of gold and regeneration of the solution with some degree of success, the solution being made to pass slowly between the electrodes, the gold being plated on to the cathode in the ordinary way. Out of the several processes devised for this purpose probably the most successful has been that of Siemens & Halske. In this process iron anodes and lead cathodes are used; when the cathodes are sufficiently coated with gold they are cupeled for the precious metal. One of the great advantages of electrical processes over the ordinary methods is that they enable a much weaker solution of potassium cyanide to be used than is necessary for the spontaneous precipitation of the gold by metallic zinc, and the strength of the solution may then be influenced only by that necessary for dissolving the gold from the ore, thus saving a considerable loss in cyanide. The electrical method of precipitation is gaining headway in South Africa and in New Zealand. According to A von Gernet, the cost of electrical precipitation for a plant on the Rand treating 500 tons of gold ore per day is as follows:

	Pence per Ton of Ore Treated.
Cyanide	3.4
Filling	10.0
Fuel, power and lime	4.5
Labor, native and white	6.9
Lead and iron	1.8
Charge due to extra cost of plant	0.5
Stores and general	3.2
	30.3

According to another authority as much as ninety-nine per cent of the total gold in the solution can be separated on the cathodes and a strength of 0.5 per cent cyanide (provided that there is no cyanicide in the ore) is sufficient to dissolve the gold at a reasonable rate. The current density generally stated to be most desirable is from 0.03 to 0.06 ampere per square foot of cathode surface and the voltage from four to six volts. The time required to deposit the whole of the gold held in solution seems to vary considerably according to the efficiency of the circulation of the liquid, but Cowper-Coles, by his process, claims to have deposited from a 0.01 per cent solution of potassium cyanide containing 2.5 pennyweights of gold per ton, ninety-five per cent of the total in ten hours, the rate of flow of liquid being fifteen gallons per 100 hours for every cubic foot of cell or three square feet of cathode surface.

Electricity in the Cyanide Process.

Many suggestions have been made for aiding the dissolution of the gold in the cyanide by electrical means, but the fundamental principle upon which they are based is weak. It is an obvious impossibility to bring any reasonable proportion of the fine gold into contact with an anode, however it may be constructed, and the mere passing of the current through the mud and thus using the small gold particles as "intermediate" or "secondary" electrodes can not be expected to help matters at all, since, the particles being so small, the current would prefer to go round them to passing through them, and thus would be of no service. Even if a small proportion did go through these particles of gold, the efficiency of the process would be almost nil.

NEW METHODS OF FUEL ECONOMY.

BY GEORGE E. WALSH.

The question of saving of labor in the boiler room has always been considered of first importance in all matters pertaining to economy of power production, and the mechanical appliances invented for accomplishing this purpose are almost infinite in their variety and working efficiency. But apparently we have almost reached a limit in this direction, and what may be called indirect economy of fuel in the past will no longer hold out alluring prizes to the inventor. To-day the direct method of saving in fuel is the one which attracts attention, and which must continue to expand in proportion to the development of our industries. Whether we consider the steam or electrical plants throughout the country, the same demand for economy in fuel is observed, and manufacturers are earnestly seeking some way to cut down the cost of their fuel outlay.

There is good reason for this, for the price of coal threatens to rise to almost prohibitive figures. With the wonderful expansion of our industries in the past decade, the call upon our coal supply has outrun all increase in the production. On the Pacific coast and in the great central states, manufacturing industries were practically shut out of existence because of the expense of fuel; but within the past few years there has developed a most remarkable change in these sections. Scores of manufacturing plants have sprung up in all of the central prairie states and on the Pacific coast simply through the use of oil as a fuel or by the harnessing of streams of water and the long-distance transmission of electrical energy. A cheap power has thus suddenly been placed within the reach of all, and the country is amazed at the rapid industrial development of the great Rocky mountain regions and Pacific coast states.

Fuel economy of a direct or indirect nature has been the cause of this industrial revolution. Electrical energy transmitted from the mountain streams of California long distances for lighting the streets, and operating cars and factories, has entered directly into competition with the users of petroleum for generating power. If it had been otherwise the price of oil on the Pacific coast would have long before this advanced so that it would have been less profitable to use it for power purposes. The advent of electrical power in the field will not only keep down the cost of engine fuel, but it may in time to a large extent supersede it entirely.

It has been shown on the Atlantic coast that the cost of fuel varies directly and very quickly with the expansion or contraction of manufacturing trade. Coal as a fuel has long been the criterion of trade. Prices for it have depended upon the industrial condition of the country. It was never so high as it has been in the past few years since our manufacturing industries reached their highest maximum. Then came oil as a fuel, and Texas and the South promised to place within the reach of all a cheaper fuel than was ever before used on the Atlantic seaboard. But the supplies of oil are after all limited, and extensive demand for the fuel inevitably increases the price. Oil has advanced with coal, and if much further increase in the price is made it will be on a par with coal. Yet indirectly the general use of oil as a manufacturing fuel improves the situation. It reduces the use of coal to a certain extent, and anything which does this must tend to check advancing coal prices. Every boiler-room appliance for saving steam, power and waste in any form acted in the same way: but the trouble has been that all these combined have failed to offset the increasing expansion of our industries dependent upon fuel for their life and growth.

The widespread use of electricity for manufacturing purposes has even a more important effect upon the fuel problem. Every time a river, stream or waterfall is harnessed for long-distance transmission of electrical energy there is a distinct saving in the fuel bill to the whole country. The demand for coal is just so much limited and restricted. A greater fuel economizer could not thus be invented by man than this. The great central Rocky mountain regions and the Pacific coast states can get along without much coal, and yet support a great manufacturing industrial life. The change affected makes these regions independent of the coal states and the owners of the mines. Likewise in the great Niagara district coal is no longer an important factor. It has been eliminated for industrial use, and it will gradually receive less and less attention as a household factor. The harnessing of Niagara has completely changed the whole face of the question.

But in the seaboard states coal must continue indefinitely as a factor in the industrial situation, and even the generators of electrical power must look to the fuel problem with anxious eyes. The boiler room is still with them one of the most important parts of their plants. Fuel economy indirectly with the use of mechanical appliances for saving fuel, and directly in burning substitutes for coal, must concern the electrical plants as much as the steam power factories. The two have similar ambitions and the same class of difficult questions to overcome. Electrical energy from the tides and ocean may some time in the future make the seaboard as independent of the coal pile as the Pacific coast region is to-day; but until such a happy realization of long-anticipated dreams, the solid, hard facts of the case must be faced. It is neither upon coal nor oil that the manufacturers can place their utmost reliance. The two are bound to seek a maximum price which will exact every pound of flesh from the manufacturers. Competition is the only factor that can change all these. A new fuel, or substitutes for coal and oil, must be discovered to fight down the rising prices for fuel, and to supply the expanding industries with all that they need to keep their factories and mills running.

The briquetting of waste fuels is probably one of the most satisfactory methods of meeting this condition. We have made great improvements in the boiler room by burning slack coal by the aid of the automatic stoker, and we have succeeded in burning coal dust by means of blasts of air driven under pressure into the furnaces; but all the economies effected in these directions are still inadequate. Waste fuel material must be briquetted and prepared for market so that it can enter into direct competition with coal. In this respect we have been far behind the European countries. Germany and England use briquetted fuel on an extensive scale, and from their point of view we are the most wasteful nation in the world in using fuel. We let waste material lie around us undisturbed, while we foster the advance of coal prices by using it freely and wastefully. The few briquetting plants established in this country in the past few years are laboring, largely experimentally, to establish an industry which shall completely change past conditions.

It is estimated that millions of tons of excellent peat are scattered over the surface of this country, covering thousands of square miles. In its present form it would be of little general use as a factor in the situation; but if briquetted and pressed into marketable shape it

would gradually prove a formidable rival to coal and oil. If these peat beds were worked successfully, and the briquetting plants permanently established with a large output, the price of coal would undoubtedly be lowered. The ordinary laws of supply and demand would cause this. In certain lines of manufacturing hard and soft coal can never be displaced by any substitute fuel, but where we find one plant limited in this respect there are a score which could use peat put up in briquette form with the most satisfactory results. The restricted use of coal would thus permanently affect the market prices, and enable manufacturers to realize profits where to-day they frequently must see them go up the chimney in smoke.

The electrical plants using fuel for generating their power could make a good start in the right direction by the general use of fuel substitutes whenever possible. In time we may find it possible to generate electrical power as cheaply with briquetted fuel as from the tides of rivers; but certainly not until a new industry of enormous proportions has been established. Meanwhile, reports are current that German briquetting companies are receiving options on the extensive peat beds in various parts of the country for the purpose of duplicating their home success in this country. Certainly this would prove gratifying to the manufacturing industries if Americans are not ambitious enough to see and make the most of their opportunities.

A SUGGESTED HYDRAULIC UNIT.[1]

BY RALPH L. MONTAGU.

There is a unit of measurement of the flow of water known as the "miner's inch." The legal definition of the means of measuring this volume varies so much in different states that the actual flow of legal miners' inches is from 1.36 to 1.73 cubic feet of water per minute. For this reason a miner's inch unless the cubic feet flow per minute that it represents is specified, can be dispensed with.

On the other hand formulæ relating to horse-power of water are based on the number of cubic feet of water per minute, or gallons, under a certain head; that is, the vertical distance of fall. I wish to suggest that a new unit composed of one cubic foot of water per minute under one foot head be recognized and a name for it suggested by members of the Institute.

This unit = 62.3808 foot-pounds.
= 0.00189 horse-power.
= 1.40994 watts.

An analogy can be drawn between this unit and the watt, inasmuch as the head in one is similar to volts in the other, and the cubic feet of water per minute takes the place of amperes in the other.

The following formula for horse-power of water is based on this unit or its equivalent value, *viz.*, 0.00189 horse-power.

$$\text{H.P.} = \frac{\text{Cu. ft. of water per min.} \times \text{hd. in ft.}}{\text{K}} \quad (1)$$

$$\text{K for any efficiency } x = \frac{52900.8}{x} \quad (2)$$

Example—A water power consists of a flow of 3,700 cubic feet of water per minute, with a total available head of 763 feet. There are the following losses due to friction resistance, etc., *viz.*:

Five per cent loss of head from friction in pipe line.

Fifteen per cent in prime motor.

Three per cent in generator.

Three per cent in step-up transformers.

Ten per cent in transmission line.

Three per cent in step-down transformers.

Two per cent in low-tension wiring.

Six per cent in motors.

Required total horse-power available at motor pulleys.

Total efficiency = 100 × .995 × .85 × .97 × .97 × .90 × .97 × .98 × .94 = 63.12.

$$\text{K} = \frac{52900.8}{63.12} = 838 \quad (2)$$

$$\text{H. P.} = \frac{3700 \times 763}{838} = 3368 \text{ horse-power available at motor pulleys.} \quad (1)$$

VALUES OF "K" IN FORMULA NO. 1.

Per Cent Efficiency.	"K."	Per Cent Efficiency.	"K."	Per Cent Efficiency.	"K."
94	562	79	669	64	826
93	568	78	678	63	839
92	575	77	687	62	853
91	581	76	696	61	867
90	587	75	705	60	881
89	594	74	714	59	897
88	601	73	724	58	912
87	608	72	734	57	928
86	615	71	745	56	944
85	622	70	755	55	961
84	629	69	766	54	979
83	637	68	777	53	998
82	645	67	789	52	1017
81	653	66	801	51	1037
80	661	65	813	50	1058

NOTE—These values are based on water of specific gravity = 1.

One cubic foot water (sp. gr. 1) weighs 62.3808 pounds.

[1] A paper presented at the 179th meeting of the American Institute of Electrical Engineers, New York, September 25, 1903.

Electric Car Lines in Germany.

Recently published figures place the total number of miles of electric car lines in Germany at 2,117. Considering the area and population of the Empire, these figures show a comparatively slow development of this branch of railway building—this, too, in spite of the fact that in electric lighting and in other applications of electricity Germany has taken advanced rank. The cause of this backwardness is to be sought mainly in the fact of state ownership of the larger part of the existing steam railways and the unwillingness on the part of city and other authorities to grant charters to private companies. Local and suburban travel is heavy, but is as yet carried mainly by steam railway lines, often of cheap construction.

The Grand Duchy of Baden, a small part of the Empire, has an area slightly larger than that of the state of Connecticut, with a population somewhat more than twice as great. In 1900 it had five cities of upward of 40,000 population, namely, Mannheim, Carlsruhe, Freiburg, Pforzheim and Heidelberg. There were in 1900 fourteen cities of upward of 10,000 population. The state includes a thickly settled portion of the Rhine valley about 160 miles long, with an average width of ten miles, which would seem to be a specially good field for electric railway lines, and yet at present electric lines are in operation only in or near the following cities:

	Length of Line. Miles.
Mannheim (including Ludwigshafen extension)	25
Carlsruhe (including line to Durlach)	9
Heidelberg (including Heidelberg-Wiesloch line)	11½
Freiburg	8

In each case the same track is used in part by the cars of several lines. Thus the total track length of the Mannheim city and suburban lines is fourteen miles.

The city of Kehl, Baden, is connected with Strassburg by a branch of the Strassburg city lines, but does not operate an independent line. Of the above lines, each belongs to the respective city except in the case of the Heidelberg city lines which are operated by a private corporation, the city being the owner of three-quarters of the capital stock.

The fare charged varies with the distance, long rides and transfers on a single fare not being permitted to the extent they are in the United States. The fare for ordinary distances is ten pfennigs (two and one-half cents), tickets good for twenty-five rides being sold for two marks (forty-eight cents).

Of the lines now in operation in Baden only two can be said to be interurban lines—a line of about nine miles from Heidelberg to Wiesloch and a somewhat shorter line from Carlsruhe to Durlach.—*H. W. Harris, Consul, Mannheim, Germany, August* 14.

European Electrically Operated Cranes.

By Frank C. Perkins.

THE use of electric power has caused quite a revolution in the operation of cranes of all types, including the portal, station and traveling jib cranes, and overhead traveling cranes for shops, and factories. The harbor and dock cranes throughout Europe have until recent years been of the steam-driven type, but electric power is now being extensively used throughout the world for this class of work.

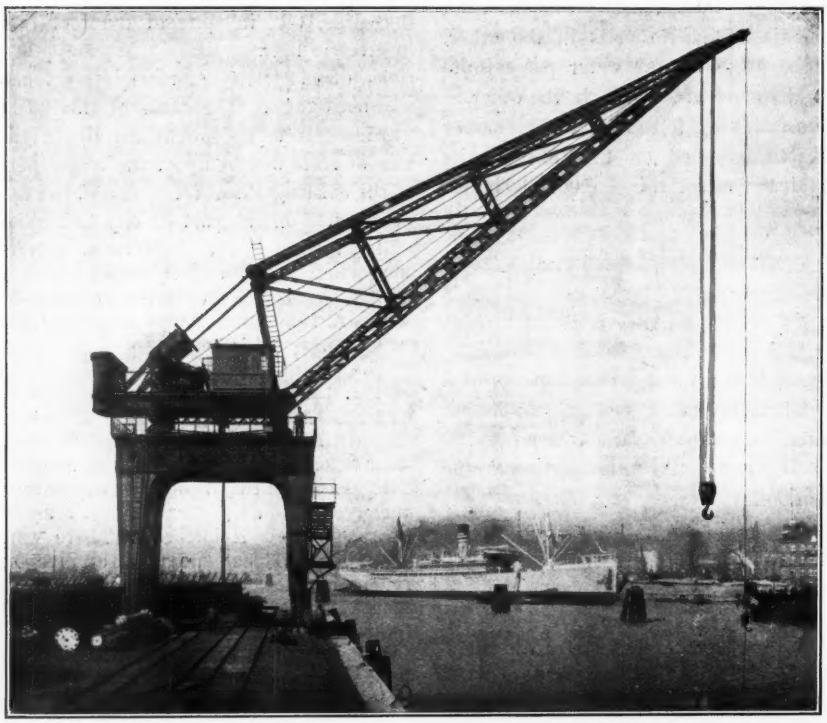


FIG. 1.—GERMAN ELECTRIC PORTABLE REVOLVING CRANE AT HAMBURG HARBOR.

Two particular advantages of the electric motive power for cranes of all sorts are the relatively inconsiderable weight of and the small space occupied by the electric motors employed for the raising, turning and traveling gears. The hydraulic crane is not economical, as the consumption of water and, therefore, the power used are in proportion to the height the weight is raised and not at all in proportion to the work done. The amount of power used is thus the same for light loads and heavy loads, and the danger from the frosts during cold weather is always troublesome, while for traveling cranes they are practically useless on account of the difficulty in supplying the hydraulic power. The steam crane also has its disadvantages in that, in addition to the engine, a boiler is required with its added attention in stoking. With the steam crane considerable fuel is wasted in keeping up steam continuously, whether the crane is in operation or not and regardless of how long the intervals may be during which it is at rest. With the steam crane the several movements required must be taken care of by a single engine or two engines at most, as the large amount of space required for three engines to answer the three movements of the crane would be excessive. With one engine a complicated driving gear is necessary, which is entirely avoided by the three-motor electric crane.

The power is easily transmitted to the electric motors on the cranes by small wires and a single controller is often used for operating the three motors, one of which raises and lowers the load, the second directs the swinging to the right or left, while the third motor moves the entire crane into a new position. These movements may be effected independently, or two or three movements may be made simultaneously, thus making it possible for the load to be carried through the shortest distance from one point to another.

The German portal revolving crane, noted in the accompanying illustration, Fig. 1, was constructed at Duisburg On-The-Rhine by the Duisburger Maschinenbau - Actien - Gesellschaft, formerly Bechem & Keetman, and is now in operation at Hamburg at the shipyard of Blohm & Voss. The jib is adjustable and it can execute a full revolution of 360 degrees. The upper carriage of the frame runs on a portal-shaped structure of compact and pleasing appearance, which has sufficient height and span to provide ample space for a double line of

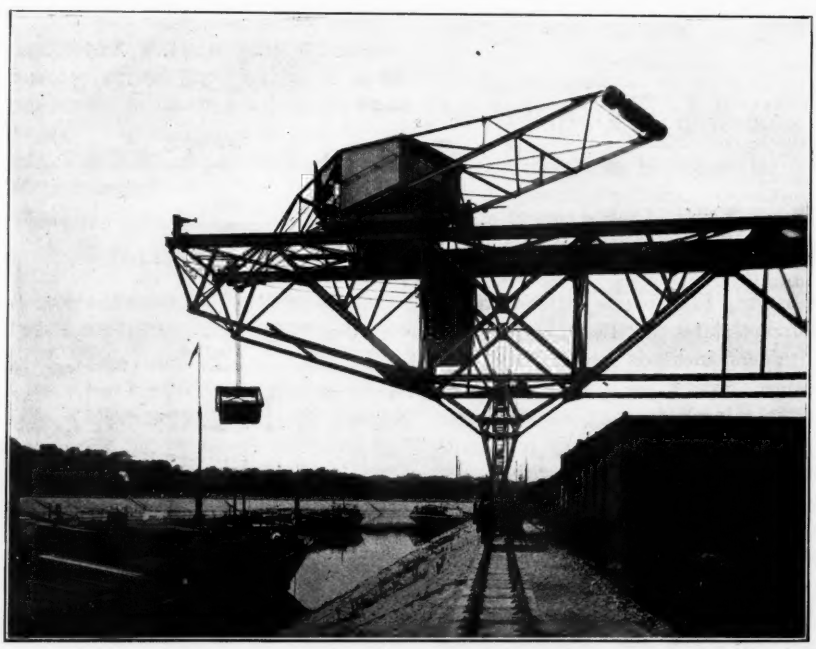


FIG. 2.—ELECTRICALLY OPERATED CRANE BUILT AT KARLSRUHE, BADEN, BY THE GESELLSCHAFT FUR ELEKTRISCHE INDUSTRIE.

rails and cars passing underneath. The gangway, which is situated on the side overlooking the water and by means of which the traffic between the quay and the ship's deck is carried on, can be adjusted according to the state of the tide.

The carriage of this crane runs on a central pivot and rests upon eight cast-iron-steel wheels, each two of which are joined by an engine beam and run on a roller path which consists of a cast-steel ring with steel rail. The driving power is supplied by a continuous-current motor, and for slewing as well as for adjusting the jib two other motors are provided. There are also two sets of lifting gear for heavy and lighter loads which are driven by a reversible motor. The increasing lifting speed is effected as the load decreases down to the empty hook by the automatic increase of number of revolution of the series motor.

With the large hook and a load of fifty tons, the highest projection of jib being 18.75 metres, the lifting speed is 2.1 metres per minute, and seventy-five tons is used as a trial load with the same highest projection of jib. With twenty-five tons the highest projection of jib is 29.3 metres and the crane operates with an empty hook at a lifting speed of fifty metres per minute. With the small hook and a load of eight tons the highest projection being 31.5 metres, the lifting speed is 15.5 metres per minute, while that of the small empty hook is forty metres per minute.

A complete revolution of the crane takes place in about two and one-quarter minutes. The lifting gear of the large hook carries the load on eight ropes and that of the small hook on two ropes, both ends of the ropes being simultaneously tightened in both of the above cases and each is wound on two drums. The drawing in of the jib is effected by two spindles of wrought steel, which work in boxes of manganese bronze. The spindles work in opposite directions so that the friction moments in the boxes are neutralized in the cogwheels of the jib and have no outward effect. The far-reaching top of the jib is constructed as light as possible, but of ample strength so that the one-sided revolving momentum created by the pressure of the wind is reduced as much as possible.

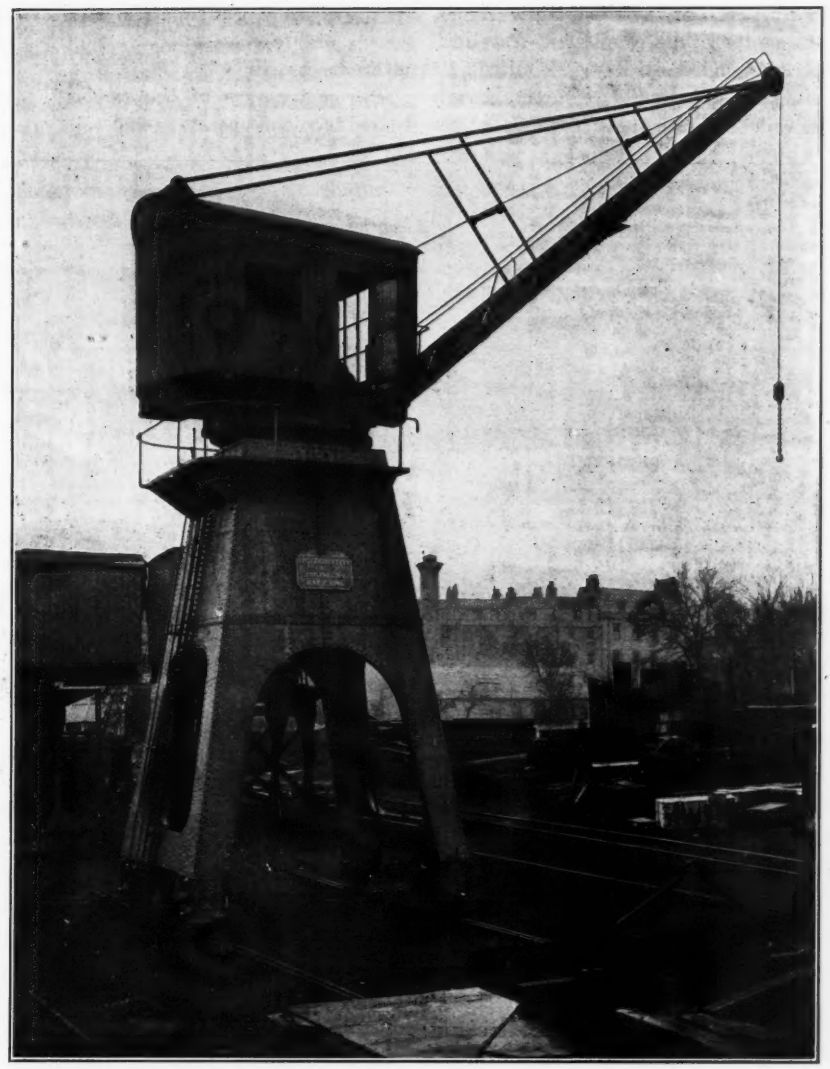


FIG. 3.—THREE-TON ELECTRIC CRANE, BUILT AT BATH, ENGLAND.

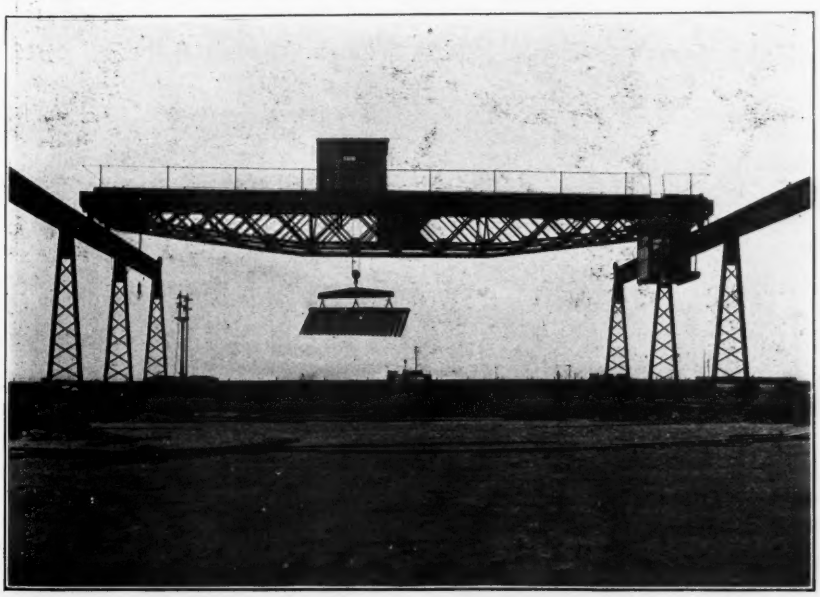


FIG. 4.—FIVE-TON THREE-MOTOR CRANE, SEVENTY-FIVE-FOOT SPAN.

The illustration, Fig. 2, shows an electric coal discharging bridge and crane at the harbor of Karlsruhe, Baden, which was constructed by the Gesellschaft Für Elektrische Industrie. A tower electric crane built at the same plant has a capacity of ten tons, the radius of the jib being six metres and the height twenty-five metres. The three-ton electric crane shown in Fig. 3 was built at Bath, England, for the Clyde trustees of Glasgow

by Stothert & Pitt, Limited, while Fig. 5 shows another type of electric traveling crane constructed by Royce, Limited, at Manchester. The legs of this crane travel upon rails laid upon the ground, while

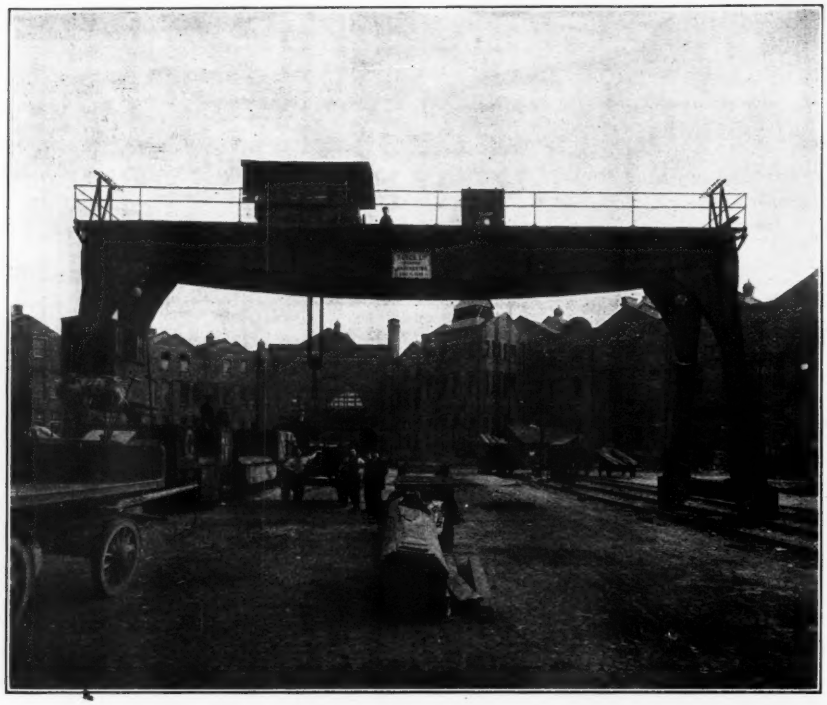


FIG. 5.—TWENTY-FIVE-TON ELECTRIC TRAVELING CRANE, BUILT AT MANCHESTER, ENGLAND, BY ROYCE, LIMITED.

the electric crane seen in Fig. 4 used for a similar purpose is operated upon rails located on elevated structures at either end of the span which measures seventy-five feet. This is a five-ton three-motor crane owned by the Cranforth Hematite Iron Company, Limited, and constructed at Huddersfield, England, by Thomas Broadbent & Sons, Limited, at their Central ironworks.

This crane has a height of lift of thirty feet, and the crane is proportioned in such a manner that the factor of safety is not less than six when operated at full load, this factor being based on the ultimate strength of the materials used.

The speed of longitudinal travel of this electric crane is 400 feet per minute, while that of the cross travel is 100 feet per minute. The rate of lifting the maximum load of five tons is sixty feet per minute, but lighter loads may be lifted and moved at quicker speeds without change of gear.

As will be noted by the illustration, the cross girders are of the double lattice type built up of steel plates, angles and tees, while the end carriages are of box section, the girders being built into them. The trolley is of open box-section steel frames and travels on steel rails placed over the centre of each girder. The steel track wheels are four in number and revolve in bronze bearings.

The motors are of the enclosed ventilated type and operate at 200 volts pressure, direct current being used. The hoisting motor has a capacity of thirty-five horse-power and operates at a speed of 500 revolutions per minute, and the motor for longitudinal travel has the same capacity and speed, while that for cross travel, although running at the same speed, has only an output of five brake-horse-power.

The electric overhead traveling crane for shops, factories and power plants has proven of such great value that it would hardly be dispensed with under any consideration, for the hydraulic, steam or compressed air overhead crane for shop practice or power-houses would hardly be as efficient or convenient as the electric cranes now in use.

Fig. 6 shows an electric overhead traveling crane of the four-motor type, having a capacity of thirty tons, installed for the Bradford Corporation, of England, by Thomas Broadbent & Sons, Limited. One of the larger erecting shops of Brown, Boveri & Company, of Baden, Switzerland, is equipped with two electric traveling cranes of fifteen and thirty tons capacity; and there is an electric alternating-current crane of fifteen tons capacity in operation at the works of the Maschinenfabrik Oerlikon, of Oerlikon, near Zurich, Switzerland.

In considering these various types of electric cranes as utilized for different purposes in European countries, it is interesting to note that foreign engineers are taking advantage of every facility which electric power places within reach for increasing the output of the workshop, for increasing the amount of material handled at the wharves in the principal harbors, and for obtaining this result with less expenditure of energy, thus giving greater economy than could possibly be attained with the older methods of operation.

FIG. 6.—THIRTY-TON FOUR-MOTOR CRANE.

According to *Terrestrial Magnetism* the Dutch Government has granted the means for a new magnetic survey of the Dutch archipelago during the years 1904-1907. During each of these years the field work is to cover two to four months, only a general survey being possible with the present means. A beginning has already been made, observations having been made on the "tin island," Billiton, and at some points in the neighborhood of Batavia, and it is also hoped to secure values at different stations in Java partly to obtain early information regarding the secular variation.

The Franklin Institute.

The Franklin Institute, Philadelphia, Pa., has issued its annual announcement and programme of lectures for the season of 1903-1904. The Franklin Institute of the State of Pennsylvania, for the promotion of the mechanic arts, was founded in 1824. At the present time the library contains 55,468 volumes, some 39,351 pamphlets, 2,860 maps and charts, and 1,240 photographs classified in catalogue. It is exclusively scientific and technical in character, and is steadily increasing in members and importance. It embraces, in addition to the standard and current works on mechanics, physics and chemistry—pure and applied—the publications of the principal scientific and technical societies of the world, files of 528 domestic and foreign scientific and technical serials, and sets of the British (and Colonial), French, German, Austro-Hungarian, Russian, Swiss, Finnish and American patent records.

A series of lectures will be delivered in Association Hall, Fifteenth and Chestnut streets, Philadelphia, under the joint patronage of the institute and the central board of the Young Men's Christian Association, beginning on Friday, October 16. The first lecture is by Mr. William J. Hammer, on "Radium and Other Radioactive Substances." In addition to this the following programme has been arranged:

Friday, October 23, 8 P. M., Dr. H. W. Wiley, chief of bureau of chemistry, United States Department of Agriculture—"Experimental Studies of the Effects of Preservatives and Coloring Matters on the Health and Digestion."

Friday, October 30, 8 P. M., Professor Eugene C. Foster, Philadelphia, Pa.—"Liquid Air."

Friday, November 6, 8 P. M., Mr. John Bradley, Philadelphia, Pa.—"Historic Philadelphia," with colored photographs.

Friday, November 13, 8 P. M., Professor R. W. Wood, Johns Hopkins University—"Fluorescence, Phosphorescence and the Chemical Action of Light."

Friday, November 20, 8 P. M., Mr. F. H. Newell, United States Geological Survey—"The Reclamation Work of the United States Geological Survey."

Tentative engagements have been made with well-known lecturers for the winter course.

In the instruction department, a drawing school and school of machine design, and a night school of naval architecture have been instituted.

In the year 1826 the institute began the publication of a journal devoted to science and mechanical arts, which has been continued uninterruptedly to the present day. The institute meets on the third Wednesday of each month, except in July and August, when papers on important scientific and technical subjects are read and discussed.

The Brooklyn Institute of Arts and Sciences.

The prospectus of the Brooklyn Institute of Arts and Sciences for 1903 and 1904 offers a very attractive series of opportunities in the department of electricity. This covers a course of eight illustrated lectures on "Recent Discoveries in Physical Science and Their Relation to Theories of Matter and Energy," by Professor John S. McKay, Ph. D., on Saturday afternoons at three o'clock; a course of six illustrated lectures on "The Electron Theory; Its Experimental Basis and Its Chemical and Physical Application," by Professor Ernest R. Von Nardroff, Ph. D., on Monday evenings; a course of five illustrated lectures on "Electric Currents," by Professor William E. Geyer. In addition to these there will be a series of illustrated lectures on subjects of current interest during the season. On October 5 there will be a lecture by Professor Harry C. Jones, Ph. D., of Johns Hopkins University, on "Physical Chemistry and the Theory of Electrolytic Dissociation," and on February 8 there will be a lecture by Professor M. I. Pupin, Ph. D., of Columbia University, on "Electric Resonance," or on a kindred subject. Visits to important electrical power stations and works will be made during the year by members of the department.

The collection of electrical apparatus belonging to the department has been transferred to the new museum building, on the Boulevard, opposite the Flatbush avenue entrance to Prospect Park. Important additions have been made to this during the past two years.

In the department of engineering a series of illustrated lectures on engineering will be held at the regular monthly meetings of the department on the fourth Friday evening of each month. This will include a lecture on October 23 by the Hon. William C. Redfield, Commissioner of City Works, Brooklyn, on "Public Improvements in the Borough of Brooklyn;" on November 27, a lecture by Mr. William Hildenbrandt, of the Department of Bridges, on "The Spinning of Bridge Cables;" on January 22, a lecture by Mr. Rudolph Hering, C. E., of the New York City Commission on Additional Water Supply, on "The Supply of Additional Water to New York City;" on February 26, a lecture by Mr. Edward Wegman, C. E., of Katonah, N. Y., on "Roman Aqueducts." Other lectures will be given by the Hon. John M. Woodbury, Commissioner of Street Cleaning, on "The Utilization of City Waste;" on "Bridges Over the East River," by Mr. O. F. Nichols, president of the engineering department, and on "The Engineer, the Contractor and the Proprietor," by Mr. F. Hopkinson Smith, C. E.

Night School Courses in Electrical Engineering.

The Casino Technical Night School, East Pittsburg, Pa., announces several special educational advantages to mechanics, clerks and apprentices. In the various works at East Pittsburg there is a large class of men who are beyond the range of college opportunities, but who will gladly devote a few of their spare hours to profitable study. This school is stated in its prospectus to be adapted to the needs of those who are willing and anxious to advance. Facilities for practical demonstrations, classrooms and a lecture hall capable of seating 350 people have been provided in the Casino buildings at East Pittsburg.

School sessions will be held at the close of shops and offices, at such hours as will be found most convenient for the students. The courses consist of mechanical-electrical engineering, mechanical-steam engineering and shop practice. Each course can be completed in two years.

The school will be under the management and personal supervision of Mr. Henri F. Chadwick, B. S., who has had considerable experience as a teacher and was formerly one of the faculty of Tufts College and of the American School of Correspondence at the Armour Institute of Technology, Chicago, Ill. A number of engineers with theoretical and practical training have been engaged upon the staff of instructors.

Light buoys using electric light, several of which have been used for some years in New York harbor to mark the ship channel in the lower bay, have now been abandoned, and the power station on Sandy Hook which supplied them with current has been closed. The electric buoys have given more or less trouble, mainly because of damaging and breaking of the supply cables by ice or other causes. They have been replaced by the regular style of Pintsch gas buoy.

THE USE OF ALUMINUM AS AN ELECTRICAL CONDUCTOR.[1]

BY JOHN B. C. KERSHAW.

Introduction—The increasing use of aluminum as an electrical conductor for bare overhead transmission lines, especially in the United States, and the claims made for this metal as a substitute for copper, led the author, in October, 1899, to commence a series of exposure tests at two localities in Lancashire, England.

These tests were made in order to ascertain the resistance to corrosion offered by commercial aluminum rod and wire under the conditions obtaining, with exposed bare overhead wires. Samples of aluminum rod and wire were obtained from the principal English firms, and in order to make the series of observations more complete, samples of galvanized iron wire, and of copper, and tinned copper wire, were also submitted to atmospheric influence. The methods of observation and the results obtained during the first exposure period (from October, 1899, to August, 1900), were described by the author in a paper read before the London Institution of Electrical Engineers on January 10, 1901.

The present paper is the record of the observations made since the date named above, and contains the chemical and physical tests of the aluminum wires exposed at Waterloo, Lancashire, together with the results obtained during two further periods of exposure, namely, from August 22, 1900, to November 6, 1901, and from November 9, 1901, to December 4, 1902.

I. Production and Price—Table I of the 1901 paper dealt with the world production and average price of aluminum in the United States down to 1899. This table has been extended to the year 1902. It will be noticed that no material alteration in the price of aluminum has occurred since 1897, although the production has materially increased.

II. Relative Costs of Copper and Aluminum—As regards the relative costs of copper and aluminum, the formula given in the 1901 paper for calculating the relative prices of equal lengths of the two metals, of equal electric capacity, was as follows:

$$\frac{S \times P \times c}{s \times p \times C}$$

where S, P and C represent the specific gravity, price and conductivity of copper, while *s, p and c* represent the corresponding values for aluminum.

Inserting the latest figures[1] for these values in the formula given above we have

$$\frac{8.93 \times 66 \times 59}{2.68 \times 159 \times 100} = \frac{34,773}{42,912} = \frac{816}{1,\ 00}$$

as the price ratio of the two metals when used for electrical purposes, and copper is seen to be the less costly metal. The price of electrolytic copper has, however, undergone such striking variations during the last twelve months that this ground of superiority over aluminum may be lost before this paper is read.

TABLE I—WORLD'S PRODUCTION AND AVERAGE PRICE OF ALUMINUM EACH YEAR FOR THE PERIOD 1890–1901.

Year.	Production in Metric Tons of 2,204 Pounds.*	Price per Pound in Pence in U. S. A.	Remarks.†
1890	165	..	
1891	233	75	
1892	487	49	
1893	715	37	Average quality. .93 to 1.64 per cent Si. .32 to 1.66 per cent Fe.
1894	1,240	30	
1895	1,418	27½	
1896	1,789	20	
1897	3,394	17½	
1898	4,033	16½	Average quality. .02 to .13 per cent Si. .12 to .32 per cent Fe.
1899	6,807	16⅕	
1900	7,743	16	
1901	7,240	15½	
1902	8,000	..	

* From the "Mineral Industry Annual," vols. viii to xi.
† From *Comptes Rendus*, 1898—Moissan's tests.

III. Installations of Aluminum for Conducting Purposes—With reference to installations of aluminum for conducting purposes in place of copper, the following must be added to the list of bare transmission lines given in the earlier paper:

1. Niagara Falls and Buffalo, U. S. A., 15,000 horse-power transmitted twenty-two miles. Three aluminum cables; three-phase transmission at 22,000 volts. Each cable made up of thirty-seven strands of aluminum wire.

2. Snoqualmie Falls and Seattle, Wash., 12,000 horse-power transmitted thirty-two miles at 30,000 volts. New aluminum transmission line.

3. Sarno, Pompeii and Forre Annunziate, Italy, transmission of 450 horse-power twelve miles at 3,600 volts.

4. Lewiston & Auburn Electric Company, U. S. A., twenty-one miles.

5. Boston & Maine Railroad, U. S. A., twenty miles.

6. Boston Electric Lighting Company, U. S. A., 100,000 pounds.

7. Shawinigan Falls and Montreal, Canada (under construction), transmission of power eighty-four miles at 50,000 volts. It is stated that 250,000 pounds of aluminum will be required for his line, which is to be made up of seven strands of No. 6 wire.

8. Massachusetts Electric Company, 500,000 pounds.

9. Old Colony Street Railway Company, Maine, ten miles.

The author has heard of only one installation of bare aluminum conductors for power transmission in the United Kingdom or in Germany, outside of the works manufacturing the metal.

IV. Durability Tests of Aluminum and Other Metals under Atmospheric Exposure—As regards the durability tests of aluminum and other wires, commenced in October, 1899, the following details from the original paper are given in order to enable those present to understand the methods of observation employed.

The rods and wire were cut into two-foot lengths, and were mounted upon glass insulators in two frames, so that their position was parallel one to the other, and all were horizontal with regard to the ground. The frames carrying the wires were so placed that the drops of water collecting upon the wires in wet weather could not by any chance pass from one wire to another, and thus bring electrolytic action into play. Each length of wire was carefully marked and weighed before commencing the exposure, and the weights recorded. The one frame with its nine insulated sample wires was exposed upon the roof of a building in St. Helens, Lancashire, from October 11, 1899, to August 23, 1900; and the second frame was similarly exposed at Waterloo, Lancashire, for the same period of ten months.

The climate of St. Helens is probably too well known to need description; but it has improved considerably in recent years owing to the closing of several chemical works. The place in which the wires were exposed is now singularly free from chlorine and hydrochloric acid gases.

Waterloo is on the Mersey, six miles north of Liverpool, and its atmosphere is that of an ordinary west-country seaside town, plus much sand. During the exposure period of ten months the frames were not touched or moved. At the end of this period the wires were removed from the frames, cleaned from the soot and dirt of all kinds which had accumu-

[1] Abstract of a paper read before Section G of the British Association at Southport on Monday, September 14, 1903.

[1] Prices of the metals in rod form, July 31, 1903 - Copper, £66 per ton; aluminum, £159 per ton.

lated upon them, and after thoroughly air-drying, were weighed.

The second set of wires which were exposed at St. Helens, were unfortunately destroyed in 1901 during repairs to the roof upon which they were placed, and consequently the exposure tests have only been continued at Waterloo.

The sample of aluminum wire marked 4, though purer than the other samples, was nevertheless badly corroded at the end of one year's exposure.

The galvanized iron wires though unchanged in appearance to the eye, gradually lost in weight—this loss being a progressive one, and greatest in the third year.

strength; but the one per cent of silicon was an unnecessary and harmful impurity. The low relative conductivity of fifty-one for this wire is only what one would expect with a sample containing over three per cent of silicon and iron.

V. Conclusions.—The author does not wish to base any unfair conclusions upon the result obtained in these exposure tests.

TABLE II—RESULTS OF EXPOSURE TESTS ON ALUMINUM AND OTHER WIRES AT WATERLOO, LIVERPOOL.

Composition and Form of Sample.	First Exposure, October 13, 1899, to August 16, 1900.		Second Exposure, August 22, 1900, to November 6, 1901.		Third Exposure, November 9, 1901, to December 4, 1902.	
	Changes in Weight.*	Remarks.	Changes in Weight.*	Remarks.	Changes in Weight.*	Remarks.
Aluminum rod, $\frac{3}{8}$ in. diameter...	Nil.	These five samples were all pitted, especially on the undersides where water drops had collected and dried.	+ .11%	Badly pitted and corroded, especially on undersides of rods.	+ .03%	Badly pitted and corroded, especially on undersides of rods.
" $\frac{1}{4}$ in. "	+ .13%		+ .18%		+ .025%	
Aluminum wire, No. 1 sample..	+ .41%		This sample was withdrawn for physical and chemical tests, August, 1900.			
" No. 2 "	Nil.		+ .50%	Badly pitted and corroded, especially on undersides of wires.	This sample was withdrawn for physical and chemical tests Nov., 1901.	
" No. 3 "	+ .55%		Nil.		+ .33%	Badly pitted and corroded, especially on undersides of wires.
" No 4 "	....	.....	..	.....	+ .87%	
Galvanized iron wire, No. 1 sample.....	— .15%	No change in appearance to the eye.	— .46%	No change in appearance to the eye.	— .54%	No change in appearance to the eye.
Galvanized iron wire, No. 2 sample.....	— .16%		— .80%		— 1.10%	
Copper wire No. 1 samp'e.....	Nil.	Oxidized on surface but not pitted or corroded.	Nil.	Tinned copper wire no longer distinguishable from untinned wire—both coated with fine black deposit of CuO.	— .10%	Wires indistinguishable, both quite black.
Tinned copper wire, No. 1 sample.....	Nil.		Nil.		— .06%	

* + equals gain, — equals loss.

Tables II and III contain the results obtained with the Waterloo set of wires and rods, during the three exposure periods extending from October, 1899, to December 4, 1902, and the facts and figures given in these two tables deserve careful consideration.

Summarizing the results recorded in table II, we may say that all the samples of aluminum gained in weight during exposure, and that all were pitted and corroded, especially on the under side where the water drops had collected and dried. The rods appeared to have suffered rather less than the wires, and it is therefore probable that in the course of drawing down into wire the aluminum undergoes physical changes.

The copper and tinned-copper wires, judging by the weight method of testing, stood exposure best, but the latter wire had lost nearly the whole of its tin covering by the end of the second year; and the wires are now indistinguishable.

Table III contains the results of the chemical and physical tests made with the aluminum wires, Nos. 1 to 4. The most striking feature of these results is, the high percentage of impurity, and the low relative conductivity of the samples of aluminum, sold for conducting purposes in the United Kingdom in the year 1899, and the slight deterioration both in breaking load and conductivity during exposure. No. 1 wire was evidently alloyed with iron to increase its tensile strength; but the one per cent of silicon was an unnecessary and harmful impurity. The low relative conductivity of fifty-one for this wire is only what one would expect with a sample containing over three per cent of silicon and iron.

He may, however, claim to have proved that some of the aluminum rod and wire which was being manufactured and sold in England for electrical purposes in the years 1899 and 1901 was not able to stand atmospheric exposure on the coast of Lancashire without corrosion. It is only a fair deduction from these exposure tests to assert, that aluminum manufacturers have yet to prove the metal to be a satisfactory and durable substitute for copper in bare overhead transmission lines, or for electrical work which involves exposure to climate near the coast.

The author's thanks are due to Dr. Glazebrook, of the National Physical Laboratory, London, for assistance received in the course of this investigation.

TABLE III—CHEMICAL AND PHYSICAL TESTS OF THE ALUMINUM WIRES USED FOR THE EXPOSURE TESTS AT WATERLOO, LIVERPOOL.

No. of Sample of Aluminum Wire.	Where Obtained and Date.	Diameter in Inches.	Chemical Tests.		Physical Tests.					
			Per Cent Fe.	Per Cent Si.	Relative Conductivity, Copper 100.	Tensile Strength, Tons per Square Inch.	Breaking Load in Kgs.		Linear Resistance—Microhms per Metre at 15° C.	
							Before Exposure.	After Exposure.	Before Exposure.	After Exposure.
No. 1.....	British Aluminium Co., 1899.	.129	2.00	1.06	51.3	?	?	157.50	?	?
No. 2.....	British Aluminium Co., 1899.	.130	Qualitative tests only —Si, Fe, Na, traces of Mn. and C.		54.0 52 1	11.93 11.86	160.5	155.25	3,870	4,330
No. 3.....	T. Bolton & Co., 1899.....	.112	.59 .55	.57	56.0	13.97 14.47	142.25	141.0	4,745	4,900
No. 4.....	Callipe & Dettmar, 1901....	.126	.41 .40	.112 .146	57.6	11.72 11.47	147.0	147.5	3,700	3,760

NOTES—1. Owing to the corrosion, no "relative conductivity" tests after exposure were reliable.
2. Chemical tests of Nos. 1, 3 and 4, by J. B. C. Kershaw; of No. 2, by the National Physical Laboratory Chemists.
3. Physical tests of Nos. 2, 3 and 4, by National Physical Laboratory officials.

AN EFFICIENT HIGH-PRESSURE WATER POWER TRANSMISSION PLANT.[1]

BY GEORGE J. HENRY, JR., AND JOSEPH N. LE CONTE.

An interesting hydraulic electric power transmission plant has recently been started in Southern California by the Edison Electric Company of Los Angeles. The water pressure or head employed is equal to 1,960 feet vertical fall, which is obtained in something over 8,000 feet of pipe line. This gives an effective pressure—after making allowances for friction loss—of considerably over 1,900 feet head, or 825 pounds per square inch, equal to fifty-five atmospheres.

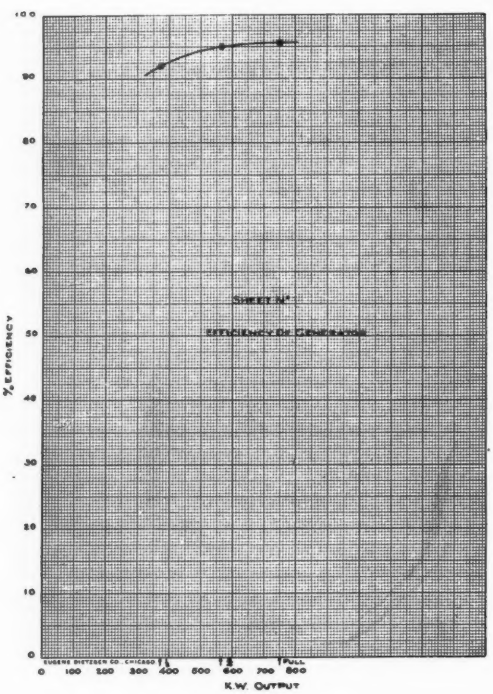


FIG. 1.

The station is located about ten miles from Redlands, in Southern California, and is used on an extensive system, including a number of other power stations, for transmitting power to Los Angeles and largely for irrigation pumping in the San Gabriel valley—celebrated for its oranges and other tropical fruits.

The generators are of 750 kilowatts normal capacity each, running at 430 revolutions per minute and the water-wheels are of the tangential type and mounted on the same shaft as the rotor. This shaft is nine inches in diameter where the wheels are pressed on, and is of forged steel, carried in three generator ring-oiling bearings—the water-wheel being located in what would ordinarily be the pulley compartment of the generator. The box bed-plate of the generator is enlarged to surround the water-wheel pit, and has an opening of three feet four inches by ten feet two inches and is planed and fitted along water-tight joints with the water-wheel housings. These are thoroughly stiffened with internal ribs and provided with centrifugal discs and pockets for preventing leakage of water from the interior of the wheel compartment to the outside, entirely without friction.

Each generator is fitted with a single wheel or runner, which, on account of the enormously high peripheral speed of 170 feet per second, is made of a special rolled-steel plate, thoroughly annealed and turned to eliminate all shrinkage strains. The high speed involved is entirely beyond the limits of safe practice for cast iron, and large cast steel discs contain such dangerous shrinkage strains, in spite of the ordinary annealing process, that it becomes dangerous to employ them under such high water pressures. In addition to the centrifugal strains in the rim of a wheel of this character, we have the strains due to water impact on the buckets. This amounts to about 22,000 on the front bolt of each of the buckets.

The buckets are of soft open-hearth steel castings, thoroughly annealed and machine ground, and polished on the inside to give perfectly smooth and true curved surfaces for the water to flow over. The front edge and centre knife of each bucket is dressed to a perfectly true cutting edge and carefully centered on the wheel rim. The buckets are cast with heavy internal projecting lugs, which are milled out and driven over the wheel centre rim.

The wheel hubs consist of heavy semi-steel castings, to which the steel disc is securely bolted by turned nickel-steel bolts driven in reamed holes. This disc is turned perfectly true all over, and carefully adjusted to a running balance at 430 revolutions per minute. In actual operation about 200 buckets come under the action of the high-pressure water jet every second.

The wheels were built for a maximum overload capacity of fifty per cent, and for continuous service of twenty-four hours a day and 365 days in the year, and no trouble is experienced from the cutting of the buckets and nozzles by the high-pressure water, as after five months' operation the wear is almost imperceptible. The water is usually clear, except for an occasional storm, during which considerable sand and gravel may be washed down into the reservoir at the top of the pipe line. The most severe storm known for many years washed considerable sand down the pipe line just after the wheels were installed and started up, but the steel buckets show no appreciable wear as the result of such severe treatment.

The main pipe line consists of 2,485 linear feet of 26-inch inside diameter sheet-steel riveted pipe, varying in thickness from 14 b. w. g. to 6 b. w. g.

Below this is 2,990 linear feet of twenty-four-inch inside diameter sheet-steel riveted pipe, made of gauges running from No. 6 b. w. g. to nine-sixteenths of an inch.

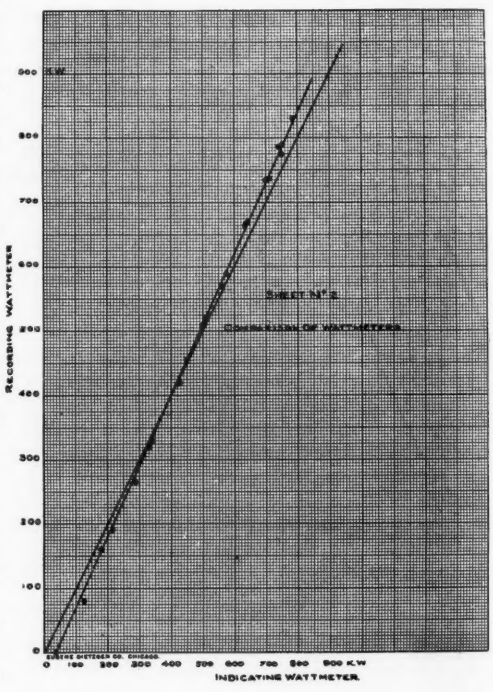


FIG. 2.

Up to this point the design of the pipe line is largely in accordance with well-known practice, but from this point down the pipe consists of:

360 ft. 24" outside dia. 1/2" thick, lap-welded steel pipe.
280 " 24" " " 9/16" " " " "
414 " 24" " " 5/8" " " " "
956 " 24" " " 3/4" " " " "

And below this:

620 ft. 24" outside dia. 3/4" thick, lap-welded steel pipe.

The twenty-foot lengths of the last 620 feet are jointed together with solid steel flanges welded on the ends of the pipe section, all of the other twenty-four-inch lap-welded pipe being put together with "bump" joints.

At the lower end of this flanged pipe

[1] A paper presented at the 179th meeting of the American Institute of Electrical Engineers, New York, September 25, 1903.

the line branches into two forks, each of which is eighteen inches outside diameter of five-eighths-inch thickness and forty-five feet in length. From each of these terminals the pipe again branches into two lines, each being fourteen inches outside diameter and one-half inch thick, lap-welded—each branch being forty feet in length and terminating just outside of the power-house wall in the cast-steel taper pipe immediately above the gates of the water-wheels. The branch from the twenty-four-inch to the eighteen-inch and the two branches from the eighteen-inch lines to the fourteen-inch are made of heavy annealed-steel castings. The main pipe line, just before the cast steel Y to the eighteen-inch branches, is supplied with a heavy pressure, outside screw and yoke, twenty-four-inch gate valve, and each of the eighteen-inch branch lines is supplied with similar high-pressure cast-steel valves so that the water supply to each of the water-wheels, or groups of water-wheels, may be entirely shut off without emptying the long pipe.

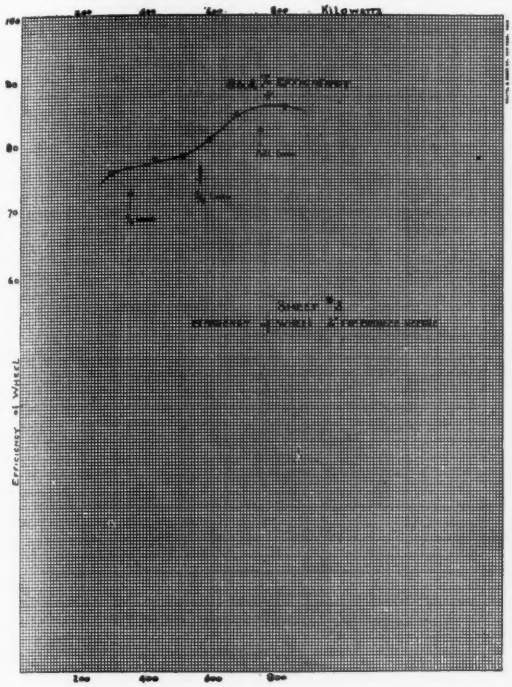


FIG. 3.

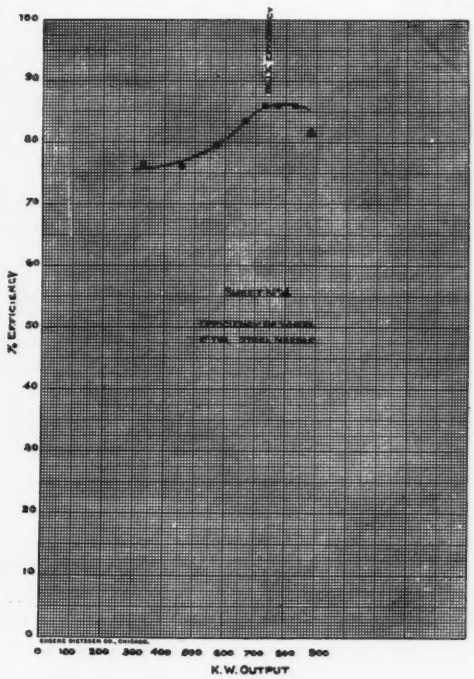


FIG. 4.

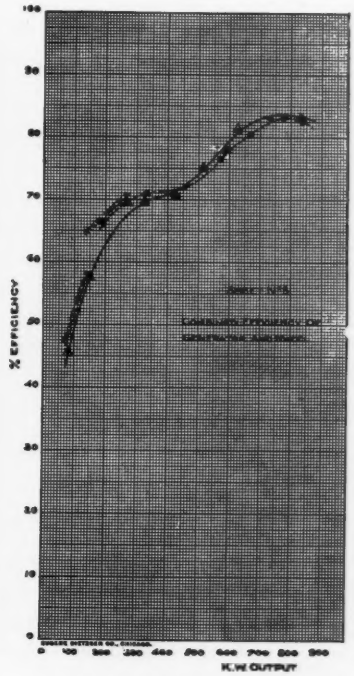


FIG. 5.

The main pipe is protected from accidental water-hammer by several air-chambers of large capacity with the necessary equipment of charging tubes, to recharge the chambers as the air is carried away in solution. The fourteen-inch branch pipes supplying each unit, feed through a cast-steel taper pipe and through a ten-inch single disc, cast-steel body gate valve of outside screw and yoke construction, with Tobin bronze valve stem and with roller bearings for taking up the thrust on the gate-nut in each direction. All of the gate valves are provided with by-passes to reduce the strain when the gates are opened or closed.

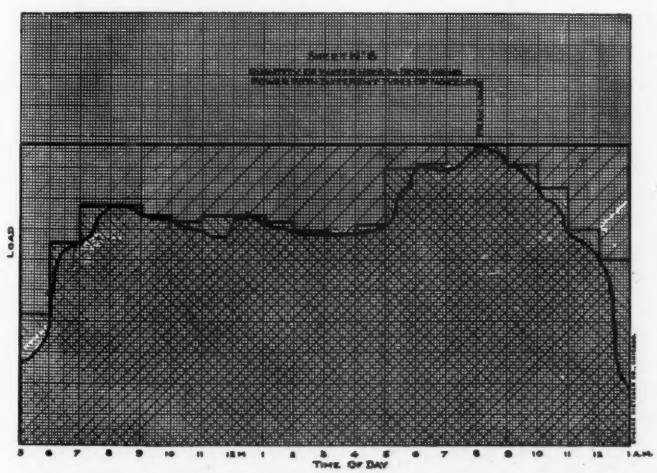


FIG. 6.

The nozzle is one of the most interesting features of the installation. It consists of a combination needle and deflecting nozzle. The deflecting joint arranged for giving the best possible regulation without water-hammer or shock in the pipe line, and water economy secured by the needle nozzle of the Clemmons type. The deflecting nozzle is fitted with a high-pressure ball joint pivoting on nickel steel trunnions, working in oil-packed gun-metal bushings and with leather-packed ball joint. By the motion of the deflecting nozzle the stream may be easily thrown on or off of the buckets by hand, or automatically by the hydraulic governor. It will be readily appreciated that this enables the operator to vary the power output from the wheel from zero to maximum instantaneously and with very small effort, without in any way varying the velocity of water in the main pipe. Absolutely no shock is thus occasioned in the pipe line by the action of the governor due to fluctuations of the load.

The most accurate regulation is further obtainable owing to the very small amount of inertia in the moving parts—the deflecting nozzle joint weighing but a few hundred pounds and being accurately counterbalanced—whereas in turbine installations the unbalanced gates and the inertia of the moving water column seriously interfere with satisfactory regulation. The governor is in no way connected with the operation of the needle, which is for the purpose of regu-

lating the flow of water through the nozzle at different hours of the day, and is accomplished through suitable geared connections to a floor stand located above the power-house floor. The method of operation is as follows:

From previous records the station attendant knows very closely the peak load that is likely to occur within the hour, and once an hour, or thereabouts, readjusts the size of the stream so that it will safely carry the peak load. The governor then takes care of the load fluctuations, maintaining a constant speed at all times by deflecting more or less of the stream from the water-wheel buckets. In this way a very great saving in water over the old deflecting nozzle when used alone is obtained.

By referring to the accompanying illustrative diagram (Fig. 6), it will be seen that the kilowatt-hours may be represented by the heavily shaded area within the load curves. The lighter shaded space, including the heavy shaded area, indicates the relative quantity of water used by this method to obtain the required output—whereas the very light shaded rectangular area, between the straight line drawn horizontal to the base and passing through the extreme peak, indicates the quantity of water which would be used by a deflecting nozzle only for accomplishing the same power output.

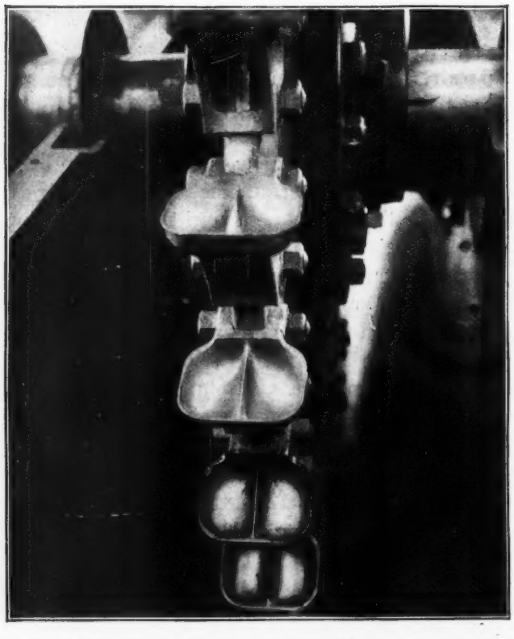


FIG. 8.—TYPE OF TANGENTIAL WATER-WHEEL BUCKETS USED IN THE EXPERIMENTS; ONE WITH PAINT PARTIALLY WASHED OUT TO INDICATE THE PATH OF THE WATER-JET OVER THE SURFACE DURING NORMAL OPERATION.

It is obvious that the best possible regulation and water economy could be effected without shock to the pipe line if the needle is moved very slowly and follows the action of the governor, closing off some of the water whenever the governor has deflected the nozzle, or opening quickly if the governor calls for more power. The quick opening will not interfere with our pipe safety, whereas quick closing by the needle would be disastrous to a long pipe line under high pressure. With the hand-operated needle and automatic governor-operated deflecting nozzle, this can only be accomplished to a limited degree, as the station attendant can not be expected to remain at the hand-wheel and adjust the size of the stream for frequent governor changes. In some of the most recent plants being constructed we are installing an automatic device for accomplishing this result. This device depends upon the action of the governor before starting its operation and, in combination with the governor, secures the best possible regulation, pipe safety and water economy. The load curve and water quantity curve being almost synchronous, the quantity of water used is about proportional to the kilowatt-hours' output, and exactly so if we leave out of consideration the partial load efficiency of the apparatus. These partial load efficiencies are, however, a very small item in a station employing a number of units and the governors should be adjusted so that they follow each other in action—all but one unit being run full loaded, and governing being accomplished on the remaining unit. A small falling off at partial load efficiency on the unit doing the governing will then represent but an extremely small reduction in the gross efficiency in the whole station.

Fig. 7 shows the curves of the needles used in the following experiments:

The needle nozzle is an extremely satisfactory device in actual operation when well designed and constructed, and the accompanying illustration (Fig. 12) of the jet leaving the nozzle under a pressure of 1,923 feet is interesting as being probably the first instance on record where the spouting stream under so high a water pressure has been photographed.

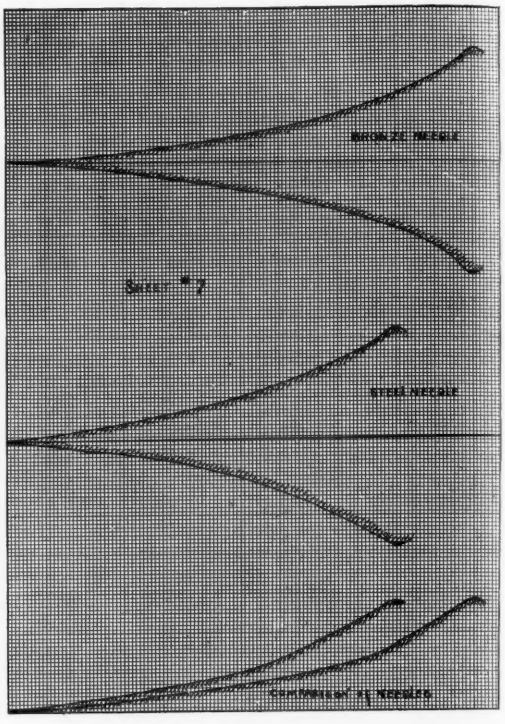


FIG. 7.

FIG. 9.—MAIN WEIR WITH HOOK-GAUGE MEASURING APPARATUS.

Fig. 8 shows the series of buckets on one of the wheels, one of which the writer painted with a coat of asphaltum varnish. After allowing it to dry for two hours, he put the wheel in operation. The wheel ran at normal load, developing about 750 kilowatts for about twenty hours before being again shut down. The bucket with the paint still remaining on it is clearly shown in the illustration. The location of the remaining paint clearly shows that the water, being discharged from a properly designed and installed wheel with this type of bucket, comes from the sides

of the bucket and not from the front or back.

For obtaining reliable data for use in the future design of water-wheels some very careful measurements were made on the efficiency and output of these wheels and the results are appended herewith in full.

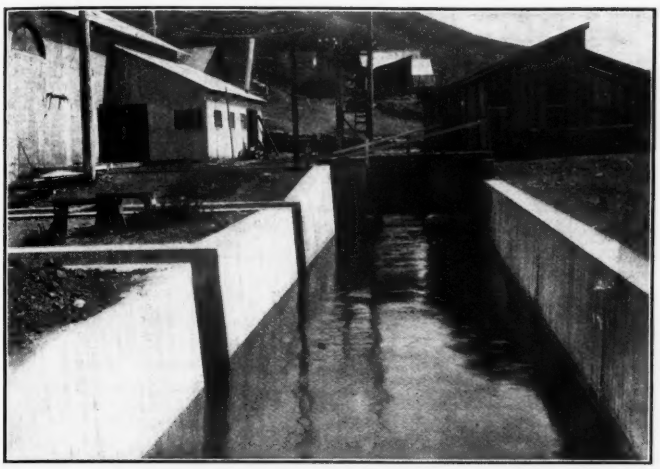


FIG. 10.—EXCITER MEASURING WEIR AND HOOK-GAUGE MEASURING APPARATUS. THIS PHOTOGRAPH ALSO SHOWS THE STILL WATER BACK OF THE MAIN WEIR.

Although the plant is being used for regular service, it is to some extent in an experimental condition; as, in spite of the high efficiency obtained, some changes are being made with a view, if possible, of still further increasing this. It will be understood that the efficiencies given and exceeding eighty-six per cent are the gross efficiencies of the water-wheel equipment, including the losses in the gate-valve and nozzle, the windage of the wheel, and such slight losses as occur in the buckets. When we consider that the total losses of this type of water-wheel apparatus summed together amount to but a little more than thirteen per cent of the theoretical energy in the water, it will be readily appreciated that the results are extremely high, and can scarcely be surpassed by any other prime mover. The thoroughly satisfactory and continuous operation obtainable from such a tangential water-wheel plant, makes it by far the most satisfactory power known for electric transmission. The maintenance and repair expenses for a plant of this character are almost negligible.

FIG. 12.—HIGH-PRESSURE WATER-JET ISSUING FROM THE NEEDLE-NOZZLE, UNDER A HEAD OF 1,923 FEET.

The units are separately excited from a generator driven by an independent water-wheel and from a separate pipe line, supplying only the exciter wheels during the test.

The object of the tests was to determine the efficiency of the wheel for different loads and styles of nozzle tips.

ARRANGEMENTS FOR TESTS AND OBSERVATIONS.

All the water delivered by the wheel under test, as well as that delivered by the exciters, was passed over a rectangular weir of ample capacity. The discharge from the exciter alone was passed over another rectangular weir first, hence the water used by the wheel under test was deduced from the difference of flow over the two weirs. The output of the wheel was determined by the electrical output of the generator, whose efficiency was given by the manufacturer down to half load.

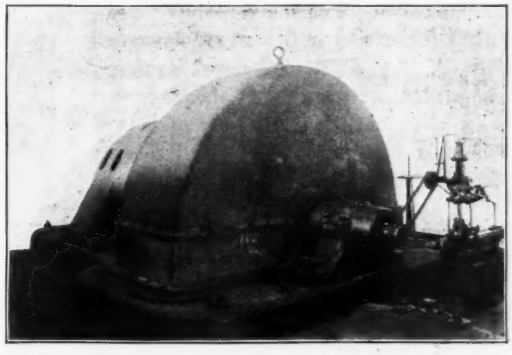


FIG. 11.—WATER-WHEEL HOUSINGS MOUNTED ON GENERATOR BED-PLATE, HYDRAULIC GOVERNOR AND CONNECTIONS AND FLOOR STAND FOR CONTROLLING NEEDLE-NOZZLE.

The effective head on the wheel was determined by the survey of the pipe line corrected by the frictional drop as deduced from the dimensions of the pipe line. This correction is so small as to be almost negligible for the quantities used, in fact a one-thousand-pound gauge located forty feet above the nozzle showed

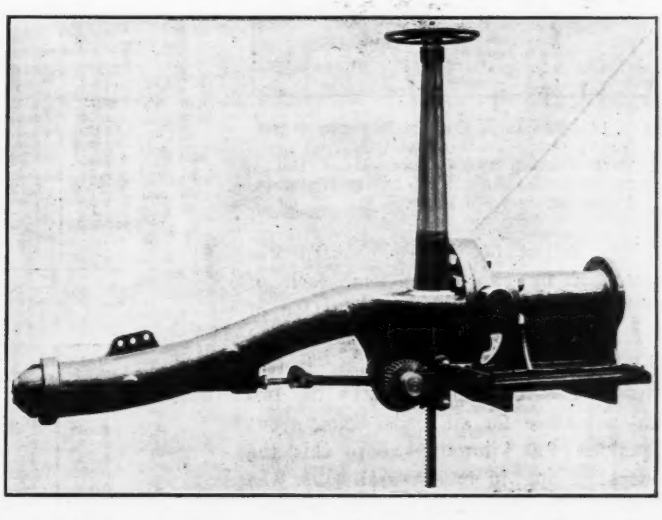


FIG. 13.—COMBINATION DEFLECTING AND NEEDLE-NOZZLE, AND NEEDLE OPERATING CONNECTIONS OF OPEN-HEARTH CARBON STEEL CASTINGS, ANNEALED.

no appreciable change between the static head and the effective head when one unit was running full power. Still the correction has been made whenever appreciable.

The large weir used for measuring the combined water of the main water-wheel and exciter was well constructed and located, though rather too wide for the quantities used. The bay above was so large as to make the velocity of approach inappreciable. The small weir for measuring the exciter water was not so well located, but, as its flow was absolutely constant, it was checked by the large weir when the main wheel was shut off. Considerable difference was observed between the measures of this latter quantity as given by the two weirs, therefore that deduced from the large weir has been adopted in the following calculations.

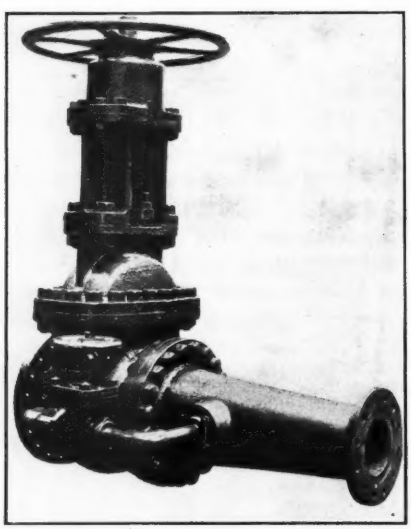


FIG. 14.—TEN-INCH ROLLER BEARING GATE-VALVE AND CONNECTIONS PUT TOGETHER WITH FORGED AND TURNED-STEEL BOLTS IN REAMED HOLES FOR THE WORKING PRESSURE OF 1,923 FEET.

The output of the switchboard was measured by two wattmeters, each of which gave the whole output. One of these was an indicating wattmeter, and the other an ordinary recording instrument. The results as given by the two did not agree for all loads, being about equal at 400 kilowatts, above this the latter reading in excess, and below the former. The comparison of the two instruments is shown in sheet 2. In the calculations which follow, the results given by the recording instrument have been taken, that being considered the more reliable.

The efficiency of the generator is taken as given by manufacturer as 95.6 per cent full load; 95 per cent three-quarter load; 92.1 per cent half load.

Calling the generator efficiency E, we have—

$$\text{H.P. wheel input} = \frac{\text{E. H. P.}}{\text{E}} - \text{(exciter H.P.)}$$

As the field excitation of the machine is ninety-seven amperes, at seventy volts, about 6.8 kilowatts are lost in the field, and the equation becomes:

$$\text{H. P. wheel input} = \frac{\text{E. H. P.}}{\text{E}} - 9.$$

Wheel efficiencies depending on switchboard instruments can not be considered as absolute and can only show in a general way the relation between efficiencies under different conditions.

RESULTS.

The following constants and formulæ have been used in the calculations:

Static head equals 1,923 feet; width of large weir equals eight feet eleven-sixty-fourths inch; width of small weir equals four feet one-quarter inch.

The quantity of water has been computed by Smith's formula:

$$Q = \tfrac{2}{3} c\, b\, h \quad 2g\, h$$
$$= \tfrac{2}{3} c\, b \quad 29\, h^{\frac{3}{2}}$$

c being taken from Smith's tables.

The available power back of the nozzle is taken from:

$$\text{H. P.} = 0.1134\ \text{Q. H.}$$

FIRST TEST.
2" Tip, Bronze Needle.
Results (Hydraulic.)

Time	Weir	Weir (Feet)	C.	Total Q.	Net Q	Friction Head	Effective Head	H.H.P.
11:35	5-1/16	.422	.616	7.23	6.15	5 ft.	1918	1337
12:27	4-17/32	.3775	.618	6.12	5.04	3.5 ft.	1920	1097
1:00	4-11/32	.362	.619	5.78	4.70	3.5 ft.	1920	1024
1:20	4-3/32	.341	.621	5.285	4.205	2 ft.	1921	916
1:30	3-13/16	.318	.622	4.78	3.70	1.5 ft.	1922	807
1:45	3-11/32	.279	.625	3.945	2.865	1 ft	1922	624
1:57	3-5/64	.256	.627	3.48	2.40	0	1923	524
2:10	2-29/32	.242	.628	3.205	2.125	0	1923	409
2:15	2-9/16	.213	.631	2.66	1.58	0	1923	345
2:20	2-17/64	.189	.634	2.23	1.15	0	1923	251
2:30	1-27/32	.1535	.640	1.65	.57	0	1923	124
3:00	1-3/8	.1145	.650	1.08	0	0	1923	0

FIRST TEST.
2" Tip, Bronze Needle.
Results (Electrical, etc.)

Time	Indicating Wattmeter	Recording Wattmeter		Power Factor	Efficiency of Generator	Wheel Input	Efficiencies.	
		K.W.	E.H.P.				Wheel	Combined
11:35	780	(826)	(1107)	.88	95.6	1153	86.2	82.8
12:27	640	665	891	.88	95.3	931	84.9	81.2
1:00	575	593	795	1.	95.1	832	81.2	78.0
1:20	500	510	684	.98	94.4	720	78.6	75.1
1:30	425	423	567	.92	93.3	603	77.2	70.7
1:45	330	320	429	.83	90.5	474	76.0	69.4
1:57	290	269	360					69.5
2:10	260							
2:15	180	146	196					57.9
2:20	125	82	110					45.5
2:30	50	—	—					—
3:00	37.5	0	0					—

FIRST TEST.
2",Tip, Bronze Needle.

Time	Weir	Indicating Wattmeter	Recording Wattmeter		Volts	Amperes	Speed
			Time	Rev.			
11:35	5-1/16	780	——	—	108	620	425
12:27	4-17/32	640	2 min -10 sec	8	108	500	432
1:00	4-11/32	575	3 " 2 "	10	108.5	450	434
1:20	4-3/32	500	3 " 32 "	10	108.5	395	—
1:30	3-13/16	425.	3 " 24 "	8	108.5	350	428
1:45	3-11/32	330	2 " 49 "	5	108	295	428
1:57	3-5/64	290	3 " 21 "	5	108.5	255	—
2:10	2-29/32	260	— —	—	107.5	240	—
2:15	2-9/16	180	1 " 14 "	1	108	205	431
2:20	2-17/64	125	2 " 12 "	1	108	200	—
2:30	1-27/32	50	— —	—	108	180	228
3:00	1-3/8	37½	— —	—	—	—	—

SECOND TEST.
2" Tip. Steel Needle.
Observations.

Time	Weir	Indicating Wattmeter	Recording Wattmeter		Volts	Amperes	Speed
			Time	Rev.			
5:10	1-25/64	375	——	—	108	0	——
5:15	2-23/32	215	2 min.-49 sec.	3	108	180	428
5:22	3-3/8	340	2 " 43 "	5	108	255	—
5:30	3-15/16	450	2 " 46 "	7	108	350	430
5:40	4-5/16	560	3 " 9 "	10	108	430	432
5:55	4-9/16	635	2 " 42 "	10	107.5	500	433
6:00	4-47/64	700	1 " 58 "	8	108.5	540	—
—	4-7/8	750	2 " 20 "	10	109	580	—
11:35	5-3/32	787	3 " 15 "	15	107	615	—

In the electrical horse-power output on the switchboard, correction has been made of four horse-power used to drive the blower, which was not recorded on the meters.

Three tests were made: First, a run on a two-inch tip with bronze needle;

second, a run on a two-inch tip with a steel needle, and, third, a single observation on a two and one-eighth inch tip, with a steel needle.

Since the efficiency of the generator is not known below half load the results of the combined efficiency of the wheel and generator are given throughout the whole range.

Sheet 1 shows the curve of generator efficiency.

The results show the necessity for very careful calculation to establish the most efficient shapes of needle and tip. When once obtained the efficiency is not only higher when the parts are new but is retained, also, for a much longer time, just as would be expected; less energy being expended in eddy currents that are an invariable cause of wear.

A diagram of the relative needle shapes is given in Fig. 7.

SECOND TEST.
2" Tip, Steel Needle
Results (Hydraulic.)

Time	Weir	Weir Feet	C	Total Q.	Net Q.	Friction Head	Effective Head	H.H.P
5:10	1-25/64	.1158	.649	1.096	0	0	1923	0
5:15	2-23/32	.226	.633	2.91	1.814	0	1923	395
5:22	3-3/8	.281	.624	3.98	2.889	1	1922	630
5:30	3-15/16	.328	.621	5.00	3.904	2	1921	851
5:40	4-5/16	.359	.619	5.705	4.609	3.5	1920	1005
5:55	4-9/16	.380	.618	6.20	5.104	3.5	1920	1112
6:00	4-47/64	.394	.617	6.54	5.444	4.5	1919	1186
---	4-7/8	.406	.617	6.84	5.744	5	1918	1252
11:35	5-3/32	.424	.616	7.28	6.189	5	1918	1347

SECOND TEST.
2" Tip, Steel Needle.
Results (Electrical, etc.)

Time	Indicating Wattmeter	Recording Wattmeter		Power Factor	Generator Efficiency	Wheel Input	Efficiencies	
		K W.	E H.P				Wheel	Combined
5:10	37.5	0	0	—	—	—	—	—
5:15	215	192	257	.81	—	—	—	66.0
5:22	340	331	443	.99	91.0	482	76.5	71.0
5:30	450	455	610	.99	93.8	646	75.9	72.1
5:40	560	572	767	.99	95.0	799	79.5	76.7
5:55	635	666	892	.97	95.5	940	84.5	80.6
6:00	700	732	982	.98	95.6	1022	86.1	83.1
—	750	772	1035	.98	95.6	1074	85.8	83.0
11:35	787	831	1114	.98	95.6	1156	85.8	82.6

THIRD RUN.
2¼" Tip, Steel Needle
Observations.

Time	Weir	Indicating Wattmeter	Recording Wattmeter		Volts	Amperes	Speed
			Time	Rev.			
3:10	5-7/16	870	2 min.-2.5 sec.	10	108	680	430

RESULTS—(HYDRAULIC)

Time	Weir	Weir (feet)	C.	Total Q.	Net Q.	Friction Loss	Effective Head	E.H.P.
3:10	5-7/16	.453	.615	8.04	6.89	7.5	1916	1511

RESULTS—(ELECTRICAL, Etc.).

Time	Indicating Wattmeter	Recording Wattmeter		Power Factor	Generator Efficiency	Wheel Input	Efficiencies	
		K.W.	H H.P.				Wheel	Combined
3:10	870	882	1181	.98	95.6	1230	81.4	78.2

Sheet 2 shows the relation between the readings of the two wattmeters.

Sheet 3 shows the efficiency of the wheel to half load for the first run, using the bronze needle.

Sheet 4 shows the efficiency of the wheel to half load for the second run, with steel needle.

Sheet 5 shows the combined efficiency of the wheel and generator throughout the whole range, with both needles.

The difference between the results with bronze and steel needles is due to the very slight difference in curvature and not in any way to the difference in material.

It is to be regretted that, in taking these measurements, only commercial instruments were available. These, however, were new and in the best possible condition, and there is no reason to believe that the readings are not absolutely correct. It is unfortunate, however, that they could not have been specially calibrated for the work.

In using the recording wattmeter as a basis for efficiency determinations, it should be borne in mind that this is an instrument that has been specially manufactured for recording the kilowatt-hours sold, and is therefore carefully calibrated in the factory, and probably more reliable than an instrument used for indicating the load on the machines only.

In the accompanying tables the amperes recorded are taken from one leg only of the three-phase circuit on which the load was well balanced. Any slight out of balance condition would, however, not materially affect the result as the ampere readings are used only to determine the power-factor.

The voltmeter readings should be multiplied by seven, as that was the ratio of its switchboard transformer.

Train Lighting by Oil Engine Units.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

The description of an oil engine in the ELECTRICAL REVIEW of September 12 reminds me of an arrangement I described to a company a few months ago.

I have had considerable practical experience with electricity and for the last year have had charge of the electrically lighted cars on one of our large railroads.

You are familiar with the different car-lighting systems in use and while they are "just the thing" for private cars they are not up to the standard for train lighting.

I propose using a first class oil engine, direct-connected to a twenty-five-light generator, and put one of these sets in each car; they would cost no more than the Pintsch gas equipment and would take up no more room than the Baker heater or stove which is being replaced by straight steam. I would then run three wires or bus-bars the length of each car with suitable couplings at each end to connect + to +, — to — and E to E, then when the train is made up the machines would all be running in multiple. In this way each car would furnish its own light with the train broken, but with the train made up the combined output of the machines would be more than enough to supply the train, and one or more sets could be cut out and held for emergency.

This company said the plan was both practical and feasible, but when I submitted the plans to the railroad they never got farther than the master mechanic's office.

I realize what a step this is in train lighting and how different from any other system, but I think with proper attention it would work successfully.

LESLIE T. BROWN.

Newport, Ky., September 19.

The 179th Meeting of the American Institute of Electrical Engineers.

The first meeting of the American Institute of Electrical Engineers after the summer vacation was held at the New York Academy of Medicine, 17 West Forty-third street, on Friday, September 25. The meeting was called to order by past-President Scott, who spoke of the spread of interest in the Institute throughout the country during the past year. It has never been so great, and credit for this must be given largely to the establishment of local branches, although those established already form but the beginning of a broad foundation for a magnificent structure in the future. Under these conditions it is very appropriate that the Institute should have elected as its president for the coming year a prominent engineer of the largest city near the centre of the country. It is with great pleasure that he introduced to the Institute its new president, Mr. Bion J. Arnold, of Chicago.

Secretary Ralph W. Pope announced to the board of directors of the Institute that 108 associate members had been elected.

Mr. Arnold then gave briefly his ideas of the lines along which the Institute should work during the coming year. He spoke as follows:

"Our new constitution does not call for a formal address from the incoming president at the time of his inauguration, as this duty is required of him at the annual convention.

"My worthy predecessor, however, outlined his course on taking office and followed it so well and with such signal benefits to the Institute, that his action prompts me to point out briefly the lines which, I believe, we should follow during the coming year.

"The remarkable development and growth of our body during the past two years has introduced many new elements which must stand the test of time and possibly be tried in a period of financial depression. Our energies, therefore, should be directed toward carrying forward the work so well started by my predecessor upon conservative lines which will ensure its permanency and the greatest good to the Institute.

"1. For obvious reasons our recent great rate of increase of membership can not continue indefinitely, and our expenditures should therefore be gauged to meet this condition.

"2. Our local chapters should, if possible, be made to last after the enthusiasm, born of novelty, has worn off, which implies encouragement from headquarters and sustained effort on the part of the local members.

"3. The work of our special committees, in connection with electrical engineering standardization and the collection of technical data, should be encouraged and additional committees appointed to extend the work in other promising directions.

"4. We should allow the authors of our papers more time for presenting them, and our members more time for their discussion, even, if to accomplish this, we are compelled to have fewer papers.

"5. Contributions making provisions for our interest in the land for the engineering building should be placed in a separate fund, which should be set apart from all other funds and to which should be credited all funds now on hand and subsequently received from donations or from the sale of bonds or other securities, especially created for building purposes.

"6. Our library fund should also be carried as a distinct fund, and all donations and appropriations for library purposes credited to it; all expenditures for library purposes to be debited to this fund.

"7. On account of the international electrical congress to be held at St. Louis in 1904, we shall be called upon not only to contribute to the scientific value of this congress, but to receive and entertain distinguished guests and members from foreign countries.

"Our plans should therefore be so well and broadly laid and executed that our guests shall return home not only fully repaid for their visit among us, but shall feel also that the splendid hospitality which was shown us as a body on our trip abroad in 1900, and to our individual members before and since has been fully appreciated.

"8. Our relationship with the other large engineering societies of this country have, during the past year, become more intimate and we are now about to join with them in the ownership and management of a union engineering building which shall meet the needs of all.

"The general preliminaries have been perfected and the work of the coming year will be the crystallization of the plans and the originating of definite means and methods for raising funds and for the material progress of the work.

"I trust we may be able to carry to a successful conclusion the work so splendidly initiated by my predecessor, Mr. Scott, and his able lieutenants, and in such a manner as not only to retain but to heighten the respect and good will of those who may co-operate with us, by the adoption of rational methods and the exercising of good business judgment in carrying on the work ensure that the generous gift of Mr. Carnegie to the engineering profession shall be ideally, and in its material culmination all that he hoped it would be.

"I wish to express my appreciation of the confidence you have shown in me by placing me at the head of this Institute, the youngest, yet one of the most progressive of the several great engineering bodies of the country.

"I sincerely thank you and I feel that you will accord to me such harmony of action and support that the coming year may be one of great benefit to our membership and add in some slight degree to the prestige of the engineering profession at large."

The first paper for the evening entitled "An Efficient High-Pressure Water-Power Transmission Plant," by Messrs. George J. Henry, Jr., and Joseph N. Le Conte, was read by Mr. F. O. Blackwell. This paper will be found on another page of this issue. It describes an hydraulic plant of the Edison Electric Light Company at Los Angeles, Cal., which is utilizing water power having 1,960 feet head.

After reading the paper, Mr. Blackwell sketched briefly the history of the development of the hydraulic plant in Southern California. He called attention to the fact that the diameter of the Pelton wheel in the plant described by Messrs. Henry and Le Conte was seven feet, while the diameter of the nozzle is only two inches, a ratio of forty to one. This ratio is very high and possibly accounts for the high efficiency of the plant. The use of needle valves, as they are described, is good, as this device not only saves water but gives a higher efficiency to the wheel, since it maintains the stream of water in the centre of the bucket. The efficiency of these wheels is considerably better than that of the early Pelton wheels. In reply to a question of the construction used in the pipe line, he said that line was constructed without flangers and without any slip joints. It takes up its own expansion caused by changes in temperature.

Mr. H. A. Lardner, of New York, gave further details of pipe line construction. The pipe line in the Santa Ana plant is of steel with flange joints. It is buried and gives no trouble from expansion. Certain curves along the line are supposed to assist in taking care of expansion. The Standard Electric Company, of Electra, Cal., has a pipe line of 1,600

feet, the first one-third of this is of cast iron, the rest of steel. Part of each section of the pipe is set in concrete, thoroughly grouted to the rock. He called attention to the fact that in the plant described in the paper but one water-wheel or runner is mounted on a shaft. In some instances two or more runners, each having its own set of nozzles, are mounted on the same shaft in the same casing. This effects a saving of water at periods of light load, as one of the runners can be shut down. In such plants it is usual to operate a number of units at constant load, one unit taking up all fluctuations.

President Arnold spoke briefly of the difference in water power installations in the East and West. In the East, where the head available is relatively small to develop considerable power, large quantities of water must be handled. Then construction becomes very expensive and in a great many cases it is found that a water power plant would be more expensive than a steam plant. On the other hand, in the West where much larger heads of water are available, and where coal is expensive, the conditions are reversed.

A paper by Mr. Aug. J. Bowie, Jr., of San Francisco, Cal., entitled "Electric Motors for Centrifugal Pumps and Fans," was read by Mr. Lardner. This paper will be published in the ELECTRICAL REVIEW. It gives a theoretical discussion of the conditions under which centrifugal pumps and fans operate and the effect of varying conditions of operation on the performance of the pump. Discussion of this paper was opened by Mr. H. G. Stott, of New York. He said his solution of the problem of determining the power consumed by a centrifugal pump would be to place a wattmeter in the motor circuit. This is the only way in which an accurate determination can be made, because a slight variation in operating conditions will vary the performance of the pump very greatly. He then said that the motor drive for condenser pumps is not satisfactory, since a slight loss of vacuum would lower the voltage at the station, this would decrease somewhat the speed of the motor, and cut down materially the flow of condensing water. The result would be that the vacuum would fall lower still and probably be lost altogether. He advised a steam drive for this work.

Mr. J. J. Brown, of New York, did not agree with Mr. Stott. Although the old type of centrifugal pump, having flat veins, would behave in the way described, with the new type the head may vary greatly, say from zero to sixty-five feet without throwing the motor out of operation. These pumps are run at high speeds, and at these high speeds a high efficiency is obtained.

Mr. Blackwell took the same stand, holding that centrifugal pumps are suitable for motor drive. A slight variation in the head may vary the output from no water to full output. He thought this was the class of work which was suitable for motors. Where high heads are to be overcome, several pumps or runners are connected in series, each delivering water to the one beyond, and each giving a head of about 100 feet. Pumps of this type are now in use overcoming from 700 to 800 feet head. The efficiency is good and is equal to that of the reciprocating pump.

A paper by Mr. Ralph L. Montagu, of Oroville, Cal., entitled "A Suggested Hydraulic Unit," was read by Mr. Blackwell. This paper will be found on another page of this issue. It suggests that a hydraulic unit be recognized and named, which is equal to the power developed by the fall of one cubic foot of water per minute under a head of one foot. This is equivalent to 1.4099 watts. In the discussion of this paper, Mr. C. O. Mailloux, of New York, took occasion to point out the desirability of the metric system which avoids the necessity for adopting many arbitrary units. In his opinion the metric system is ideal for water power engineering calculations.

Secretary Pope stated that a regular place for holding the meetings had not yet been decided upon. The arrangement with the New York Academy of Medicine for the hall they were then using had been for that night only. The meeting was then adjourned.

Electrical Progress in Russia.

It is only within the last few years that Russia has shown any desire to advance in matters electrical, but one notable feature in the progress which has been made is the extensive use of electricity for motive power in factories and works. It is stated that practically all machine shops in Russia have adopted the electrical drive, and enormous central stations have been erected at places where such factories exist. However, up to the present, electricity has scarcely been used at all for the transmission of energy over great distances. The government has recently granted a concession to a company to furnish power to St. Petersburg from the Volhoy rapids. The scheme is estimated to involve a cost of nearly $15,000,000. Power will be transmitted 188 miles. There is another scheme to use the colossal force of the Dnieper river for the generation and transmission of electrical energy. There are many Russian factories which produce cables and insulated conductors. Accumulators are also manufactured in various towns, and such appliances as circuit-breakers, commutators, rheostats, etc., are also made there, but not nearly enough to supply the demand. Measuring instruments are scarcely manufactured at all, these being imported from France and Germany. The manufacture of porcelain insulators has been so well developed as to supply completely the home demand. Incandescent lamps are not manufactured in Russia, and most of the arc lamps are imported from Germany. Signaling and telegraphic apparatus is supplied by the home factories, but the demand for apparatus and machines is little satisfied by them.

Elimination of Platinum in Incandescent Lamps.

The high price of platinum has brought about many attempts to manufacture incandescent lamps without the use of this material, but as yet no other metal has been found which will fully replace it. The reasons for the use of platinum are that its coefficient of expansion is the same as that of glass, and therefore changes of temperature do not cause cracking. A further reason is that when platinum is fused into the glass the latter adheres to the platinum as though cemented. While other metals, particularly some alloys such as nickel steel, have been found, which have a coefficient of expansion equal to that of glass, none of them has the property of forming a tight joint when fused in. To get over this difficulty a French company which manufactures incandescent lamps has discovered a cement which enables it to secure a tight joint around the leading-in wires, without it being necessary to use platinum. This cement is said to be unaffected by air or ordinary temperatures.

Mr. John Clarke Hawkshaw, president of the British Institution of Civil Engineers, thus estimates the world's water power: Assume a depth of ten inches of rainfall to flow off each square inch of land surface, the mean height of which may be taken as 2,250 feet above sea level. Then the water from the whole surface falling through the mean height would give 10,340,000,000 horse-power in perpetuity. Our present yearly output of 225,000,000 tons of coal would give that horse-power for only a little over half a day.

TWO WESTERN POWER AND LIGHTING PLANTS.

THE COLORADO ELECTRIC POWER COMPANY, CANON CITY, COL., AND THE TRINIDAD PLANT OF THE LAS ANIMAS LIGHT, POWER AND MANUFACTURING COMPANY, TRINIDAD, COL.

BY J. H. RUSBY.

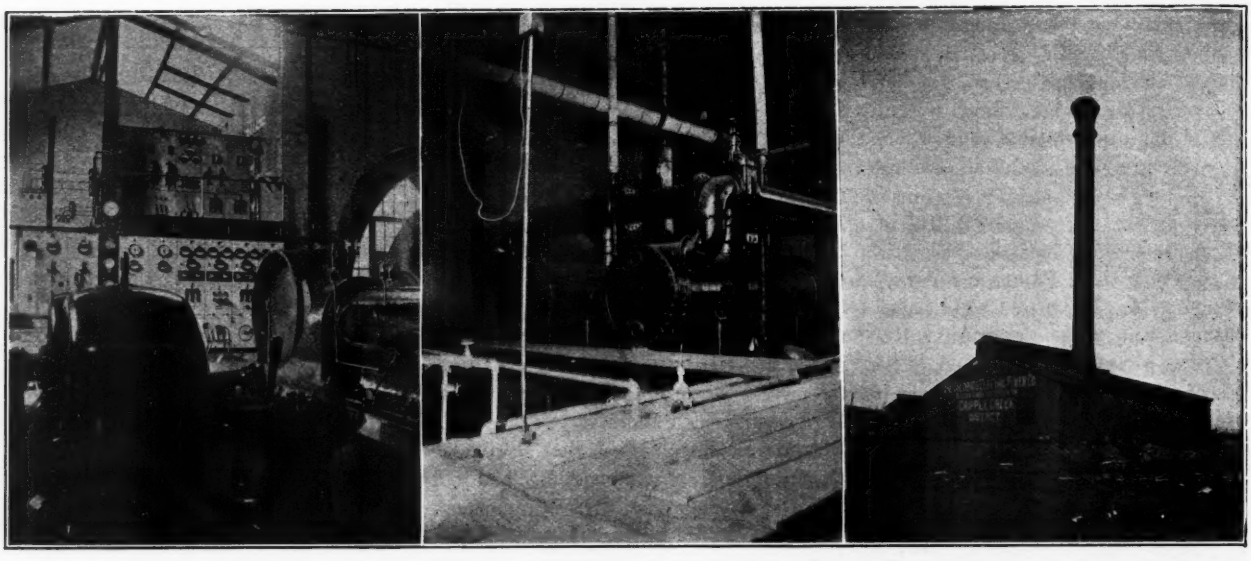
The generating station of the Colorado Electric Power Company, of Cañon City, Col., is situated on West Main street. The building is constructed of red brick, with an iron roof, and is of fireproof material throughout. The dimensions are 50 by 150 feet. A steel stack twelve feet in diameter and 150 feet high is set on a brick base sixteen by sixteen feet and thirty feet high, giving a total height of 180 feet from the floor to the top of the stack.

The boiler equipment consists of four Heine water-tube boilers of 400-horse-power capacity each, heated by slack coal fuel. There are two Snow condensers, two boiler feed pumps, and a complete outfit of auxiliary apparatus.

The engine equipment consists of three 600-horse-power, Hamilton, cross-compound, Corliss engines, direct-connected to three 500-kilowatt alternating-current generators giving thirty-cycle three-phase current at 500 volts. These generators are separately excited by two Westinghouse sets, consisting of Westinghouse upright engines and thirty-seven-kilowatt direct-current dynamos.

The current is taken to a double-deck switchboard, consisting of eight panels of two-inch gray marble on the lower or primary section, and five two-inch gray marble panels on the upper section. These boards are equipped with a complete outfit of up-to-date apparatus for measuring and controlling the output of energy, including oil break switches for the high-voltage circuits and quick break knife switches for the low-voltage circuits.

Westinghouse oil transformers step up the current as follows: For local lighting it is stepped up to 2,500 volts and the various circuits are then fitted with pole transformers which step down the current for local consumption. In addition there is a 500-volt circuit through the town for supplying power to various consumers, which include an ice manufacturing plant, several printing offices, a stone sawing yard, two planing mills and various other industries, including an ore smelter out of town which is served by the 2,500-volt street circuit.



ENGINE ROOM AND SWITCHBOARD, BOILER ROOM, AND EXTERIOR VIEW OF POWER PLANT, COLORADO ELECTRIC POWER COMPANY, CANON CITY, COL.

The Colorado Electric Power Company supplies a great part of the Cripple Creek district, and for this load the current is stepped up by a set of Westinghouse oil transformers to 22,000 volts and is then transmitted over a pole line carrying three No. 3 bare soft-drawn copper wires for a distance of twenty-seven miles to the Cripple Creek district. Here it is stepped down to suitable voltages for supplying street and house lighting circuits, mining hoists and other mining machinery, besides supplying most of the power for the Cripple Creek electric street cars.

Edison base sockets and lamps are used throughout the installation.

Prices for current range from three to six cents per kilowatt-hour for power, and from ten to fifteen cents per kilowatt-hour for lighting.

This plant claims the record for continuous running, having had no stop since some eighteen months ago, when a cloudburst and flood which destroyed much property forced it to shut down for a few hours.

THE TRINIDAD PLANT OF THE LAS ANIMAS LIGHT, POWER AND MANUFACTURING COMPANY.

The generating station of the Trinidad plant of the Las Animas Light, Power and Manufacturing Company is situated near the centre of the city of Trinidad, Col., alongside the tracks of the Santa Fe Railroad and opposite the railroad station.

The boiler equipment consists of one 200-horse-power Stirling water-tube boiler and three eighty-horse-power Sterns horizontal boilers, all heated by slack coal fuel. There are four feed-water heaters, the water circulating about the outer portion, while the hot gases from the furnace are exhausted through the centre.

The engine equipment consists of one 150-horse-power Ball engine and two eighty-horse-power Ball engines with Ball valve gear, together with one forty-horse-power and two eighty-horse-power Armington & Sims horizontal automatic spring-governed engines.

The generator equipment consists of one alternating-current, fifteen-kilowatt, separately excited Thomson-Houston generator, supplying two-phase current at 1,000 volts; two twenty-five-kilowatt, Edison direct-current 125-volt generators; two fifty-kilowatt, Westinghouse direct-current 125-volt generators; two Thomson-

Houston thirty-light constant-current and two Western Electric forty-light constant-current series open-arc machines, all of which are belt-driven.

Current is distributed to street circuits through a wooden switchboard fitted with plain knife switches. Edison and Weston instruments are installed. All low-voltage connections are made with bare copper. The high-voltage arc and incandescent system has enclosed fittings.

Westinghouse pole transformers are used for alternating-current incandescent lighting, stepping the current down to 110 volts for inside use.

The present load is about eighty arc lamps and 2,800 incandescent lamps, with about 4,000 incandescent lamps wired in.

The rates are $5.40 per arc lamp per month on a moonlight, twelve o'clock service; all-night service, $8; residence lighting, incandescent, fifteen cents per kilowatt-hour; store and office incandescent lighting, twelve and one-half cents per kilowatt-hour. The plant capacity is to be extended by the addition of an eighty-horse-power tubular boiler and a fifty-kilowatt generator, to supply the increased demand for light. This company also operates the gas system for the city.

New South Wales Railway and Tramway Ambulance Corps.

The New South Wales (Australia) Railway and Tramway Ambulance Corps is perhaps the best organized and most efficiently drilled of any similar organization known. I have personally, as a physician, thoroughly investigated it, through the courtesy of the chief medical director and of the commissioners and secretary of the New South Wales Railways, and find that it is well worthy of the first place on the list.

The corps was commenced before the present commissioners took office, but at the time of their doing so (in October, 1888) it had a membership of only 191. At the present time the membership numbers about 1,800 certified by examination as capable of rendering first aid; but more than double that number of the employés have received instructions, although, owing to the nature of their duties, many are unable to attend a complete course and therefore have not presented themselves for examination, though in many cases possessing a very good knowledge of ambulance work. The membership is widely distributed, members being found in every branch of the service, in the workshops, and at every station of importance throughout the system.

The desirability of having such a trained body of men connected with the railways of this state is very great, the circumstances of the New South Wales lines differing materially from those in older and more thickly settled countries, where towns are close together and medical aid is readily procurable. Here, however, the lines run at times for 100 miles without passing a settlement of note, and should an accident occur on such a stretch of line it is of great importance that those on the spot should be able to render "first aid" to the injured and be equipped with the appliances essential in treating injured persons.

In regard to appliances, it may be mentioned that every passenger train running outside the suburban section, and mixed trains on branch lines, are fitted with a medical chest and all ambulance requirements in case of an accident. Ambulance equipment is also kept in reserve at a large number of railway stations, and each wrecking car is fitted with a medical chest and full equipment. The ambulance equipment in August of last year, the date of the last annual report of the corps, comprised 126 chests, 254 stretchers, forty hampers or small boxes, seven wheel litters at large centres, and one ambulance wagon (horse) at Sydney, the terminal station.

The work of instruction is conducted by the railway medical officer, who regularly visits the various centres throughout the state. He is assisted by some of the older members of the corps, who, as branch secretaries, advance the interests of the corps by keeping members in touch and proficient by periodical drills and by the formation and carrying on of additional classes. Much assistance is also rendered by medical men in some of the larger centres in the country. To deal with the detail work in connection with the working of the corps and to promote its interests generally, a competent officer has been appointed as general secretary, the whole of whose time is devoted to the work, his salary being paid by the commissioners.

With the view to encouraging the staff to take a course of ambulance training, examinations are held annually of the various classes and each member passing the primary examination, which includes the practical treatment required in rendering "first aid," is presented with a framed ambulance certificate. A second course of a more advanced character is provided for, and successful candidates at this examination are presented with a silver medal suitable for wearing as watch guard. As a special acknowledgment of the exceptional services rendered by some members, gold medals have been presented in a few cases.

For the purpose of increasing the interest in the movement the commissioners some years ago instituted a challenge shield for annual competition among the different branches of the corps. This is a handsome trophy, and each year the names of the winning squad of four men are inscribed on a space provided for the purpose, space being allowed for ten years. It should be added that small gold replicas of the shield are given to the winning team each year, the second team having similar replicas in silver and the third in bronze.

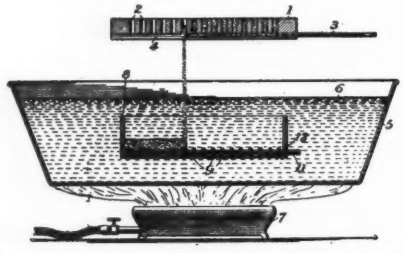
As a further encouragement the commissioners have annually given monetary grants, amounting last year to $1,250, which is distributed among branch secretaries, who maintain a certain number of drills to keep up efficiency. It should be mentioned that the commissioners grant free passes to employés to enable them to attend classes.

The practical value of the knowledge gained by the members of the corps has been manifested on a number of occasions, and the efficiency and skill of the treatment rendered has often been warmly recognized by the medical men who have subsequently treated the cases. The aid of qualified members is often called into requisition, and annually several hundreds of occasions are reported to the corps secretary of such service having been rendered, many cases of accident to members of the general public and unconnected with the railways.—*F. W. Goding, Consul, Newcastle, New South Wales, July* 14.

In a recent communication to the British Royal Society, Sir William Ramsay and Mr. F. Soddy tendered some evidence bearing upon the suspected gradual conversion of radium or radium emanation to helium. Twenty milligrammes of pure radium bromide were dissolved in water and gas was given off which consisted of hydrogen and oxygen. These two gases were removed and the residue examined for helium, and one of the helium lines was found in the spark spectrum. In another experiment practically all the helium lines were obtained. In still another series of experiments radium emanation was condensed in a liquid-air tube and the liquid air was then removed by a pump. The tube showed no trace of helium, but showed a new spectrum, probably that of the emanation itself. After standing for four days the helium spectrum appeared and the characteristic lines were observed, identical in position with those of the helium tube thrown into the field division at the same time.

Electrical Patents.

Mr. Oliver P. Fritchle, of Denver, Col., has patented a process of producing active material and electrodes for storage batteries and products thereof. This invention relates to the production of a crystalline non-disintegrating active material of the utmost electrical conductivity and molecular porosity which will allow the freest possible diffusion of the electrolyte on charge and discharge. The new active material may either be compressed into a self-supporting electrode or may be carried by a suitable support or grid. The invention is based on the discovery that finely divided lead, especially when produced by spraying molten lead by means of a blast, obtains a peculiar cohesive property as if in a molten state when subjected to a hot dilute solution of hydrochloric acid and may be welded together into a rigid but highly porous mass by subjecting it to light pressure. The treatment with acid causes a slight evolution of gas, which prevents the particles of lead from settling into a dense, compact mass. The apparatus comprises a device 1 for holding and showering the finely divided lead. This device is a rectangular plate, which may be of wood having a large number of perforations or slots 2 extending entirely through it. A slide 3 is arranged to move in contact with the lower surface of the plate and is supported by rabbeted parallel guide-strips 4, secured beneath the edges of the plate. A vessel 5, which may be a shallow porcelain-lined pan, contains a body of dilute hydrochloric acid 6, preferably a five per cent aqueous solution. Beneath the pan is a gas heater 7, by which the acid solution is brought to a high temperature. A receiver 8 is supported within the pan at some distance above its bottom and directly beneath the showering device 1. This receiver is a shallow rectangular tray of material which is inert toward the acid solution, such as copper. The bottom of this receiver is detachable and has a large number of perforations 9, adapted to receive projections on a grid, allowing the body of the grid to lie flat on the bottom of the receiver. A horizontal slot 10 is cut through one wall of the receiver at or slightly above the inner surface of its bottom, through which may be inserted a grid or plate 11 to receive the treated lead. A strip 12 closes the slot. In employing this apparatus to carry out the process the receiver 8, containing the grid 11, is placed in the pan 5, and the acid solution is heated to a high temperature, preferably to its boiling-point. The apertures in plate 1 are filled with granulated lead previously sieved to a size between sixty and one-hundred mesh, the slide being closed, and the device is placed directly above the receiver 8. The slide is now slowly withdrawn, and the lead falls through the hot acid solution into the receiver and on to the grid 11. The action of the acid solution on the granulated lead quickly causes it to become coherent, as if in a molten state, and the treated mass will occupy about four times the original volume of the lead. The lead is now compressed to about twice its original volume, preferably while it is still within the hot solution. It is important that the treated lead should be compressed without delay, as its property of welding is soon destroyed by the continued action of the acid. The pressure required is comparatively slight, depending upon the required porosity of the mass, and may be effected by a hand-press with screw-and-toggle mechanism. The bottom of the receiver is now detached, and the grid, with the compressed active material on one of its faces, is pushed out and again inserted with the coating of active material below. The bottom is replaced, and the other face of the grid is provided with a coating of active material by repeating the described operation. While the use of a conducting or non-conducting grid or support is often desirable, this element is not essential. The granulated lead after passing through the acid may be received directly on the bottom of any suitable vessel and compressed into a highly porous and self-supporting electrode of sufficient rigidity for practical use. While the process is preferably carried out by the use of the described acid solution, a solution of any other acid, salt, or compound which will yield chlorine to the lead may be substituted, or chlorine water or chlorine itself may be employed. The use of lead which has been granulated by a blast is preferable as the shreds and filaments interlace when the treated mass is compressed, giving the body greater rigidity and firmness.



PROCESS OF PRODUCING ACTIVE MATERIAL AND ELECTRODES FOR STORAGE BATTERIES.

Mr. George Hail, of Providence, R. I., has devised a threshold-illuminating device for elevators, his idea being that, as many accidents are caused by persons attempting to leave or enter an elevator car when the latter is stopped with its floor out of level with the adjacent landing, an illuminated threshold will call the attention of the passenger to any inaccuracies of the kind. The invention is, therefore, believed to be particularly ad-

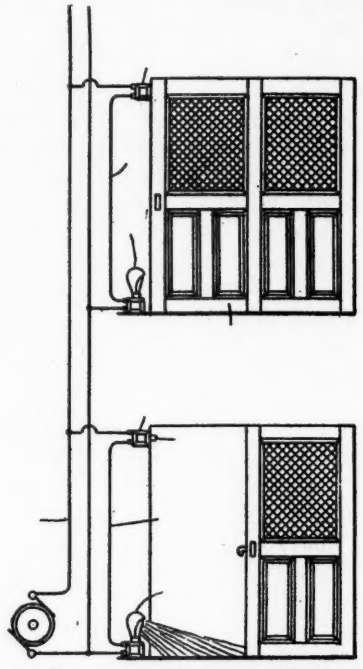


FIG. 1.—THRESHOLD ILLUMINATING DEVICE FOR ELEVATORS.

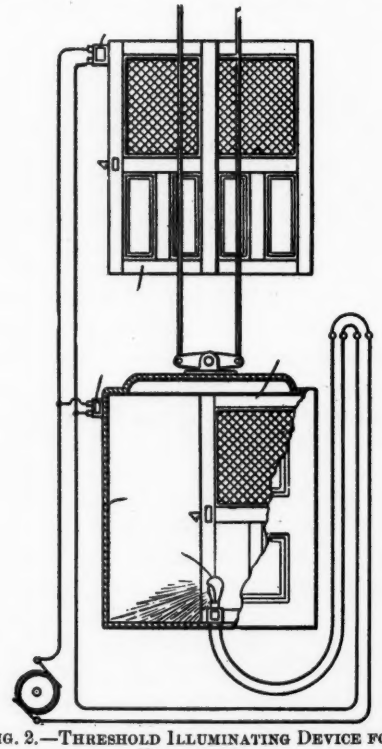


FIG. 2.—THRESHOLD ILLUMINATING DEVICE FOR ELEVATORS.

vantageous where the car and the well are not satisfactorily lighted, so that the passenger is unable to appreciate the difference in level. Several different forms of the invention are proposed by the patentee. In one he employs an electric circuit extending from the top to the bottom of the elevator shaft and having branches therein that are located at the different landings, as shown in Fig. 1. These branch circuits include an electric lamp so arranged that it will throw light directly upon the landing. A switch is also included in each branch circuit and is normally held open by the elevator door when closed. As soon as the elevator door is opened, however, by the conductor of the elevator, this switch will close, thus closing the circuit through the lamp and causing the same to illuminate the landing. In another form of invention a lamp is carried by the elevator, as shown in Fig. 2, and is automatically illuminated as the car reaches the different floors.

Two Englishmen, Messrs. William Peto and James W. T. Cadett, of Ashlead, England, have taken out a patent in this country on a new composition of matter for battery electrolytes. The composition consists of powdered or precipitated sulphate of lead moistened with dilute sulphuric acid of about the average strength used in electric accumulators, which ingredients are combined in about the following proportions, *viz.*, finely precipitated sulphate of lead, one pound; dilute sulphuric acid of about specific gravity 1.2, four ounces. These ingredients are thoroughly mixed together either by hand or mechanically until they form a soft plastic mass of a paste-like consistency. The proportions stated above are subject to some variation, according to the quality of the sulphate of lead, as some descriptions of sulphate of lead take up more acid than others, while the strength of the acid is varied within ordinary limits, according to the purpose for which the accumulators are to be used. The requisite proportion of acid can be easily regulated by allowing the mixture to stand awhile, when any excess of acid will rise and float on the top and can then be poured off. Sufficient acid must, however, be used to render the composition soft and plastic, for if it be made too stiff the gasing may produce air-spaces therein that may impair the efficiency of the accumulator.

An ordinance has been introduced in the Columbus, Ohio, city council, fixing the price of electric current for the next five years at six cents per kilowatt for lighting and four cents for power purposes.

Effect of Vacuum on the Steam Turbine.

The steam turbine is very sensitive to a vacuum. A couple of inches additional vacuum will increase the efficiency of a turbine much more than it would that of a reciprocating engine. It is easy to see why this should be so. In the reciprocating engine of the most refined type more than twenty expansions are rarely used, usually less. In the steam turbine 100 expansions may be easily realized. Conceive of a steam diagram with twenty expansions. If the counter pressure could be lowered two pounds, an area would be added to the diagram equal to the product of the width representing that pressure and the length of the diagram. Suppose now the number of expansions be increased to 100. Since the length of the diagram represents the final volume, the diagram would be five times as long and the lowering of the counter pressure line two pounds would add five times as much area as it did in the former case. In addition to this area, another gain is derived from the further expansion.

With equal ratios of expansion, as where both engines exhaust against a pressure of, say, five pounds above the atmosphere and the reciprocating engine diagram ends in a point, the turbine will probably be less efficient than the reciprocating engine. The turbine owes its efficiency to the large ratios of expansion which it can utilize and even with these ratios is able to attain efficiencies only equal at best to those of the best piston engines. The reciprocating engine suffers some twenty per cent from internal condensation, due to the alternate heating and cooling of its surfaces. The turbine suffers probably more from lack of mechanical efficiency. When steam is confined its pressure is positively exerted upon the containing surfaces and any increase of volume is positively productive of the corresponding amount of power. In the turbine the energy of the steam is first put into inducing motion in the jet or current and then the turbine is used to absorb it. This it can do perfectly only by bringing the steam to absolute rest, and in the absence of eddy currents and friction. The best water turbines convert only about eighty per cent of the energy of the water, and probably the steam turbine is no more efficient as a turbine, so that whatever advantage the turbine may have over the reciprocating engine in the avoidance of internal condensation is probably offset by its lack of efficiency as a motor.

Another reason why the vacuum is of particular value to a turbine is the reduction which it effects in the windage. A top will spin for an enormously long time in a vacuum. If it had to spin in an atmosphere of compressed air or high-pressure steam, its motion would last for a comparatively shorter time. At the high speed at which the turbine vanes are run the frictional resistance in the dense high pressure steam of the earlier stages must be considerable, but in the much less dense atmosphere of the later stages much less of the energy absorbed is used in overcoming friction. Of course energy can not be continuously imparted to steam in a confined space without heating it, so that the heat developed by this and other forms of fluid friction may go to improving the quality of the steam and preventing its condensation. Since the turbine is less efficient than the reciprocating engine in the early stages of the expansion, but is capable of carrying the expansion practically to so much greater an extent, the idea suggests itself that the turbine might be used to replace the low-pressure cylinder of a compound engine. This would mitigate the loss from internal condensation, as all the heat which goes into the first cylinder, with the exception of that lost by radiation and converted into work, must pass to the receiver and would be available for use in the turbine through the lower temperature range. Great ratios of expansion would be available and the enormous cylinders necessary for even the limited ratios now attained would be avoided. The simplicity and compactness which are such attractive features of the turbine would be, however, in a measure sacrificed, as would the particularly advantageous use of superheated steam and the avoidance of oil in the condensed exhaust. —*Power.*

A Proposed Electric Railway in Switzerland.

A correspondent in the London *Times* says that it has been proposed to build a new railway running to the top of Mount Blanc. This line would start at Les Houches, the village at the top of the gorge of the Arve and at the entrance of the Chamonix valley, and end at the Janssen Observatory on the actual summit. The line would be a rack and pinion one, and the motive power would be electricity generated from dynamos worked by turbines, the water power of the river Arve being utilized for this purpose. This fall already supplies current for the Fayet-Chamonix Railway. It is estimated that the cost of a ticket to the top of Mount Blanc would be about $20, which would be comparatively cheap as compared with the $50 or $60 that must be expended at present on guides and porters and for lodging.

Reviews of Current Engineering and Scientific Literature.

The Wittfeld System of Train Lighting.

This system of train lighting has been used on three lines of the Prussian state railway—from Berlin to Sassnitz, from March, 1902; on the line from Berlin to Hamburg and Altona since November, 1902, and from Berlin to Hamburg and Kiel. In this system a twenty-horse-power steam turbine driving a small generator through gearing by a reduction of ten to one is mounted on the locomotive boiler. The generator is entirely enclosed, and after being started and adjusted is governed by an enclosed regulator. The speed of the generator is 2,000 revolutions per minute. It has an output of 12.6 kilowatts, and the voltage can be varied between sixty-four and ninety-five. Each car is equipped with an accumulator, the elements of which are contained in hard rubber jars with hard rubber covers. As the voltage of the batteries varies considerably, in series with each lamp is placed a ballast consisting of a fine iron wire sealed in a glass tube which is filled with hydrogen. This ballast is so designed that a change of nine per cent in the current strength produces a change of 300 per cent in its resistance. When in operation it shows a dull red glow. Throughout the length of the cars two main leads are run, carried in iron tubes. From these branch the circuits to the battery and to the lamps. In putting the system into service the engineer brings the generator up to speed and then, by means of his voltmeter, he adjusts the potential to about four volts above that of the batteries. No further attention is required, as the regulator controls the potential and an automatic switch cuts out the generator as soon as the batteries are fully charged.—*Translated and abstracted from the Centralblatt für Accumulatoren-Elementen und Accumobilen-Kunde (Gross Lichterfelde West), September* 1.

Tests on Variable Speed Motors.

One way of varying the speed of direct-current motors is to change the strength of the magnetic field by varying the length of the air-gap. This system is used in a well-known American make and has been adopted by a French house. In these machines, which are here described by M. Courbier, the air-gap is varied by shifting the core of the field pole. Two types of motor have been built—bipolar and multipolar. In the former the two cores are shifted by means of a toggle-joint operated through a screw and nut, the latter being attached to the frame of the motor and turned by a hand-wheel. In the multipolar machines the poles are moved simultaneously by means of a ring forming really a system of inclined planes which, when turned in one direction or the other, shift the pole cores in or out. In all the motors the cores are carried on ball bearings to overcome friction. Against this method of regulation it has been urged that the motors are inefficient at high speeds. The author has conducted tests to determine the weight of this objection. Curves are given for the performance of a two-pole machine with a normal rating of twenty-eight amperes at 220 volts. The curves show that at full load this machine had an efficiency of eighty-six per cent at 500 revolutions per minute. The efficiency rose to eighty-seven per cent at 600 revolutions, and then fell practically along a straight line to eighty per cent efficiency at 1,800 revolutions. At half load the machine had an efficiency of eighty-four per cent at 500 revolutions. This rose to eighty-five per cent at 600, and then fell evenly to seventy-eight and five-tenths per cent at 1,800 revolutions. At full load the efficiency falls six per cent from the maximum with an increase in speed of 200 per cent.—*Translated and abstracted from the Bulletin de la Societe Internationale des Electriciens (Paris), July.*

A Basis for the Comparison of Dynamo Designs.

Various coefficients useful in comparing the merits of alternative designs have been suggested by Kapp, Steinmetz, Mavor and Thompson. These coefficients are here discussed by Mr. H. M. Hobart, who takes the stand that while they have been useful to the designer, they are comparatively unsatisfactory for use in final comparisons, because they neglect to take into consideration the end connections. He therefore suggests a coefficient for the "specific output," found by dividing the rated output in watts by the product of the cylindrical surface of the armature and the speed in revolutions per minute. To show that the specific output, as thus defined, is a true criterion of commercial economy obtained in the given design, the coefficients given for a number of machines of the same general type are plotted on rectangular co-ordinates, the ordinate being the cost of the machine. The results given by machines made by four separate companies in each case fall very nearly on a straight line. From the data given for costs, that machine is of the most economical design in which, when complying with a given specification, the maximum "specific output" is obtained. To illustrate this point eight generators with an output from 200 to 1,600 kilowatts, and designed by five engineers, are compared by plotting the "specific output" against the rated output, reduced to a common speed. The specific output varies from 0.038 to 0.163, the points falling fairly well on a regular curve. Variations from this curve may be due to special design or abnormal rating, and do not necessarily indicate poor design. Curves plotted in this way show that for every speed there is a rated capacity beyond which the "specific output" decreases. The point of maximum "specific output" is obtained at lower rated outputs the higher the rated speed. Dynamos built on present approved designs do not reach these maximum points on account of commutating limitations. —*Abstracted from the Electrician (London), September* 11.

The Cause of the Earth's Magnetism.

Many theories have been put forward to explain the earth's magnetism. The one here discussed by Mr. William Sutherland attributes this to electrical charges existing on the earth. There is strong evidence as to the two distributions of electricity throughout the substance of the earth. In Helmholtz's theory of chemical valence of the atoms, each bond between the atoms in a molecule is supposed to consist of two opposite electrons associated with the atoms. Every molecule then involves in its own existence that of at least one or the other charge. The whole earth, therefore, contains two opposite enormous charges of electricity. These are so nearly equally distributed throughout the earth that they produce no external electrical effect. If the two charges were distributed in absolute equality, their magnetic fields would exactly neutralize one another, and we should have no terrestrial magnetism. The author then considers what differ-

ence in the distribution of the earth's two charges would be required to account for its magnetic field, and he finds that if the negative and positive electricities in the earth are spread over concentric spheres whose radii differ only by the diameter of a single molecule, they can account for the earth's primary magnetic field. Upon this theory magnetism must be a property of all rotating bodies. It is the comparatively minute outstanding difference between the two opposite magnetic fields generated by the opposite electricities, associated with matter. In this aspect it reminds one of surface-tension, which reveals the play of molecule forces that escape ordinary observation. To carry the present theory of steller magnetism further, the main desiderata are, first, a demonstration of the difference in the attraction of matter for the two sorts of electricity; and, second, a determination of the law of attraction between matter and electricity, to ascertain whether it is such as to cause negative electrons in molecules to take up the position which, on the whole, is farther from the centre of the earth than that taken by positive electrons.—*Abstracted from Terrestrial Magnetism and Atmospheric Electricity (Baltimore), June.*

Electricity on the Farm.

Although electrical power is well suited for farmwork, there are comparatively few farms where it is used to any great extent. M. E. Guarini in this article describes three European installations which are of interest. At Simmern, Germany, power is obtained from the river for operating a turbine driving an eleven-kilowatt 110-volt dynamo. This machine is used to charge a battery of accumulators with a capacity of ninety-five ampere-hours for a ten-hour discharge, and operates much of the farm machinery. The motors have been selected to replace, as far as possible, men and animal power. They are all easily portable, and where there are a number of machines needing a certain power, it has been considered sufficient to install only one motor powerful enough to work them all. Individual driving has been avoided. At Simmern one motor is of ten horse-power, runs at a speed of 1,200 revolutions per minute, and is mounted on a truck. It was not possible to do all the work of this farm with this one motor, so a number of small motors mounted on portable platforms are also used. At Quednau power is generated by a steam-driven dynamo. The output of the generator is forty-five kilowatts. This is reenforced by a battery of accumulators. Power is distributed at 500 volts and is used for lighting and heating the buildings. There are three motors at this farm. The one with a rating of two and one-half horse-power is fixed, and is used for driving cutting machinery. There are two portable motors, one of them being rated at fifteen horse-power. At Crottorf, Germany, a water power is utilized, but a reserve steam unit has been installed. At this station alternating current is generated at 7,000 volts, there being three 500-kilowatt alternators. Power is distributed over districts within a radius of thirty kilometres. The average demand on this station is about 450 horse-power. What has been especially tried at Crottorf is the use of electricity for threshing grain. The threshing machine is driven with a portable motor and is connected to the high-pressure mains, wherever necessary, through a portable transformer.—*Abstracted from the Electrical Review (London), September 11.*

An Oscillation Galvanometer for Measuring Electromagnetic Rays.

The description recently published of a magnetic detector invented by Dr. Fleming has led Herr Erich F. Huth to describe an apparatus which he has constructed for the same purpose—that of making quantitative measurements of electromagnetic waves. The apparatus, which is called an oscillation galvanometer, consists of a bundle of thirty steel wires having a diameter of one-tenth of a millimetre and a length of sixteen millimetres, mounted upon an ivory rod. Upon this rod is also attached a reflecting mirror, and the system thus constructed is supported by a phosphor-bronze strip and held in tension by a phosphor-bronze spring. Damping wings are also attached to the moving part. Around the bundle of steel wires is wound a magnetizing coil to which current is led from a storage battery by means of the suspending and torsion wires. In use, a current of 0.12 of an ampere has been found most satisfactory. When set up for use this apparatus is connected in the antenna circuit, so that any oscillation set up in the antenna will cause currents to pass through the magnetizing coil and thus to the earth or a condenser. To make an observation, a current is passed through the magnetizing coil, magnetizing the steel wires and causing the movable system to take a steady deflection due to the opposing forces of the earth's field and the torsion wire. If, then, an electrical oscillation impinges upon the antenna, the oscillating currents passing through the coil cause a demagnetization of the steel wires, proportional to the intensity of the wave. The deflection then diminishes in a corresponding degree, the difference between the two deflections being read off by means of a telescope and scale. The instrument may be used in another way: If an electrical wave strikes the antenna while the current from the storage battery is passing through the magnetizing coil, the magnetization of the wire is increased, and an increased deflection is caused which is also proportional to the intensity of the wave. To illustrate the sensibility of the apparatus it was connected to an antenna 257 metres in length, placed 227 centimetres from the sending antenna. With a distance of 175 centimetres from the mirror to the scale, a deflection of 250 millimetres was caused when a potential of fourteen volts was applied to the induction coil, the spark being allowed to pass through air.—*Translated and abstracted from the Physikalische Zeitschrift (Leipsic), September.*

Good Telephone Talking.

To be a good telephone talker is something of an art, but in these days it should, by all means, be cultivated as much as any of the methods of polite conversation. The first requisite is the proper pose. In all cases the transmitter should be as nearly vertical as possible, with the voice funnel so adjusted that it is on a level with the lips when the head is in the ordinary arched position of conversation. Then the lips should be held about an inch away from the funnel and directly opposite its centre. The speaker should talk in a tone slightly above the ordinary conversational pitch, about in the same way as if he were speaking to a person across the room.

But more than all, care should be taken to talk slowly and to articulate with the greatest distinctness. To be deliberate in what one says, and to make ample pause at the end of each sentence. The telephone is such a time saver that one even over a toll line need not be unduly worried in being in too much of a hurry to get through. On the contrary, time and annoyance for one's self and one's correspondent will be saved by talking slowly and allowing a little time for the mental reception of the ideas that one wishes to transmit. Nothing can be more erroneous in the use of a solid back than to stand at a distance from the instrument and endeavor to effect it by shouting at the top of one's lungs.—*American Telephone Journal.*

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Twenty-two Thousand Horse-Power in Steam Turbines for Pennsylvania Railroad.

An order for three steam turbines of the largest size has recently been placed with the Westinghouse Machine Company, East Pittsburg, Pa., by Westinghouse, Church, Kerr & Company, acting as engineers and constructors for the Pennsylvania Railroad in connection with the New York terminal equipment.

These machines will form the initial installation in the new Long Island power-house, on which construction is just beginning and which will serve the traction in the tunnels for the Hudson and East rivers and the New York terminal at Thirty-second street and Seventh avenue, and also such part of the Long Island Railroad system as is in process of conversion to electric traction.

The turbines will be of the Westinghouse horizontal short barreled type, mounted upon a single bed-plate, resulting in a particularly compact arrangement and great economy of floor space; they will have a capacity of approximately 7,400 electrical-horse-power each, and will drive 5,500-kilowatt, three-phase, alternating-current generators, operating in parallel. Their overload capacity will be over 11,000 horse-power and each turbine will be provided with a by-pass automatically controlled by the governor to accommodate abnormal fluctuations in load. This will also permit operation at full load, non-condensing.

The turbine equipment will operate under conditions favorable to the attainment of high economy, *viz.*, 200 pounds steam pressure at the throttle, twenty-eight inches vacuum and 175 degrees Fahrenheit superheat.

The generator will be direct-connected to the turbine shaft through a flexible coupling, each section of the unit having two bearings of ample proportion, thus avoiding shaft stresses. The three-phase winding will deliver current directly to the distribution system at 11,000 volts, no step-up transformers being employed. The machines will be separately excited and will carry full load continuously at 100 per cent to eighty per cent power-factor, with a rise in temperature of thirty-five degrees centigrade, or fifty per cent overload for two hours with an increase in temperature rise of slightly over fifty per cent. Each turbo-unit will thus be capable of delivering 8,250 kilowatts for reasonable intervals and considerably in excess of this figure during momentary load fluctuations.

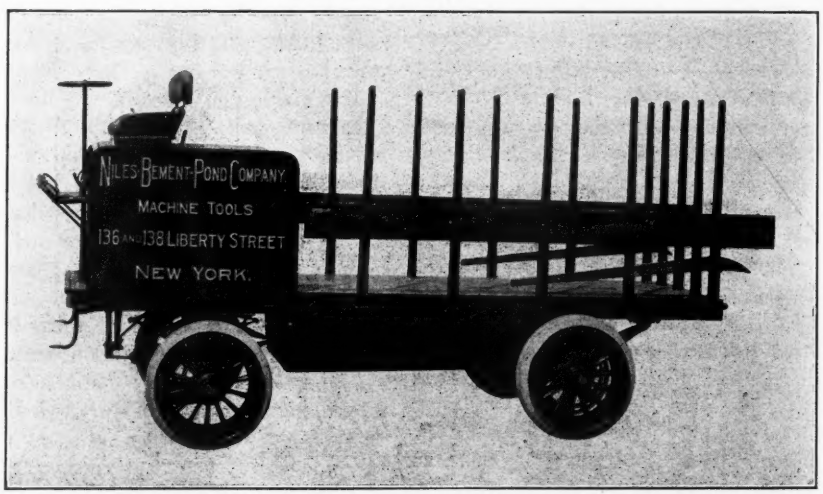
The entire equipment will be delivered by July, 1904, one year from the date of contract. It is somewhat significant of the state of the turbine industry that eleven Westinghouse turbines of approximately the same size are under construction for heavy electric railway service, both in this country and abroad.

A Heavy Service Electric Truck.

The Niles-Bement-Pond Company, New York city, N. Y., one of the largest machine tool companies in the world, obviously has a great amount of trucking to be done. The interesting features in connection with this is, that the greater part of this trucking is accomplished by means of an electrically driven truck which was built by the Rainier Company, of New York city. The advantages which the electric truck possesses over the ordinary truck drawn by a team of horses are many. One of the many advantages peculiar to this style of truck, which is an important one, as it is also labor-saving, is the electric windlass which is placed under the seat. This is operated by an independent motor and controller, the power being derived from the storage battery. This apparatus will hoist five tons at a rate of eight feet per minute, and has all safety appliances, including break, ratchet-pawl and reverse controller.

The body of the truck is sixteen feet long by five and a half feet wide. It is built on the "Gibbs" system of steel frame construction, with what is known as "pedestal" running gears, instead of the "reach" system heretofore used on electric vehicles. The "pedestal" is a single steel casting fastened to I-beam body frame and has diagonal brace bars for support. The axles are placed in the jaws of this "pedestal" and have absolute freedom vertically, but none whatever laterally. This overcomes the intricate mechanism resulting from split axles, differential gears, etc.

The I-beam steel frame relieves the vehicle body of any strain and tendency to buckle, and at the same time offers substantial support for suspending the battery, and leaving the inside of the wagon body absolutely clear. The battery is made in sectional trays which slide out at either side and are of the type used in the Rainier Company's equipment. The power is furnished by two motors of General Electric make, and operate independently on rear wheels. The tires are six inches, solid rubber. Forward springs are full eliptic, the rear, one-half eliptic. A double brake operates on the inside of rear wheels, being worked by foot power. The controller has four speeds ahead and two reverse, the maximum speed of truck being five and a half miles per hour. The battery has a capacity of twenty-five miles on a single charge.



HEAVY SERVICE ELECTRIC TRUCK.

Every passenger coach now being built in the shops of the Pennsylvania Railway Company, in Philadelphia, Jersey City, Altoona and Pittsburg, is wired for electric lights, in addition to having an illuminating gas installation.

Motor-Driven Bolt Cutters.

The accompanying illustrations show two new bolt cutters which have been designed by the Reliance Machine and Tool Company, of Cleveland, Ohio. These machines are a distinctive departure from the heretofore standard type.

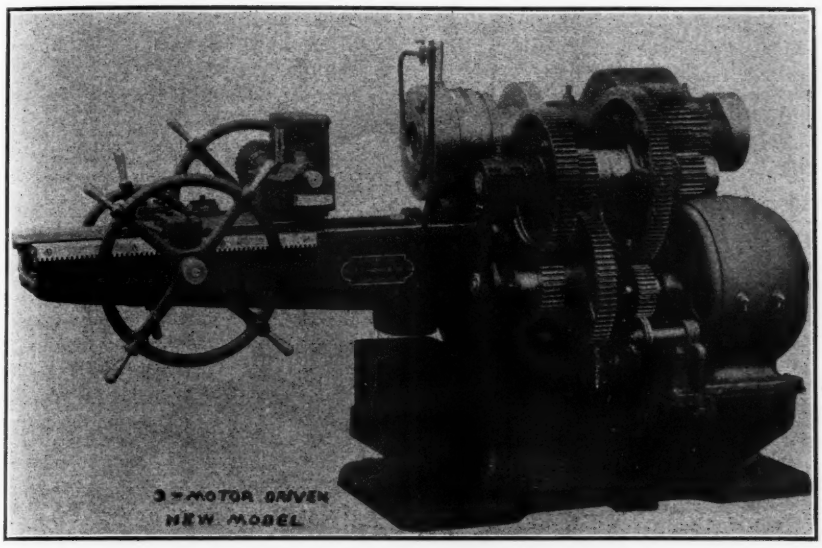


FIG. 1.—THREE-INCH BOLT CUTTER, EQUIPPED WITH ELECTRIC MOTOR AND CONTROLLER.

Fig. 1 shows a three-inch bolt cutter equipped with a Crocker-Wheeler motor and controller. A new and significant feature is found in the method of driving the head spindle or shaft, the driving gear of which is located centrally between the bearings of the spindle, instead of being at its extreme end. A system of compound gearing makes it possible to obtain greater power without having an unduly large driving gear. This method of driving the head spindle eliminates all torsion, producing a smoother and more rapid cut without chattering.

The oil and chips which work through the hollow spindle do not prove a source of trouble by falling upon the belt and pulley. The working parts are all accessible, and the floor space has been reduced by the compact design of the machine. In the belt-driven machine a four-step cone pulley takes the place of the gear meshing with the motor pinion.

Fig. 2 shows the standard type of motor-driven bolt cutter manufactured by this company. This machine is a two-inch single-bolt cutter equipped with a Crocker-Wheeler variable speed reversible motor. The speed variation obtained by field control is as one to three, and the motor is connected by means of spur gearing directly to the machine.

The motor, being fastened to the back of the machine, is readily accessible, free from grit and oil, and occupies very little floor space. Gear covers are furnished if desired.

The Reliance Machine and Tool Company reports a strong demand for this class of tool, and states that a general and growing tendency toward electrically driven machinery is very evident.

An Electric Car Lighting System.

The Kinsman Electric and Railway Supply Company, New York city, has developed an electric car lighting system which keeps the headlight and also the interior lights working, whether the trolley is on or off, or the power stopped for an indefinite time. This work is accomplished, it is stated, at a low cost for installation and maintenance. In installing the car lighting system the present method of lighting (by five lamps in series, usually) is not interfered with, except by the introduction into the lamp circuit of an automatic shunt and a small secondary battery placed under the car seat, the latter being connected in multiple with supplementary low-voltage lamps in the car or headlight, or both. A switch such as now used serves to bring the present as well as the supplementary systems into service. The secondary batteries are long-lived, owing to the fact that under ordinary circumstances comparatively light service is required of them, and the same is true of the supplementary lamps for the same reason.

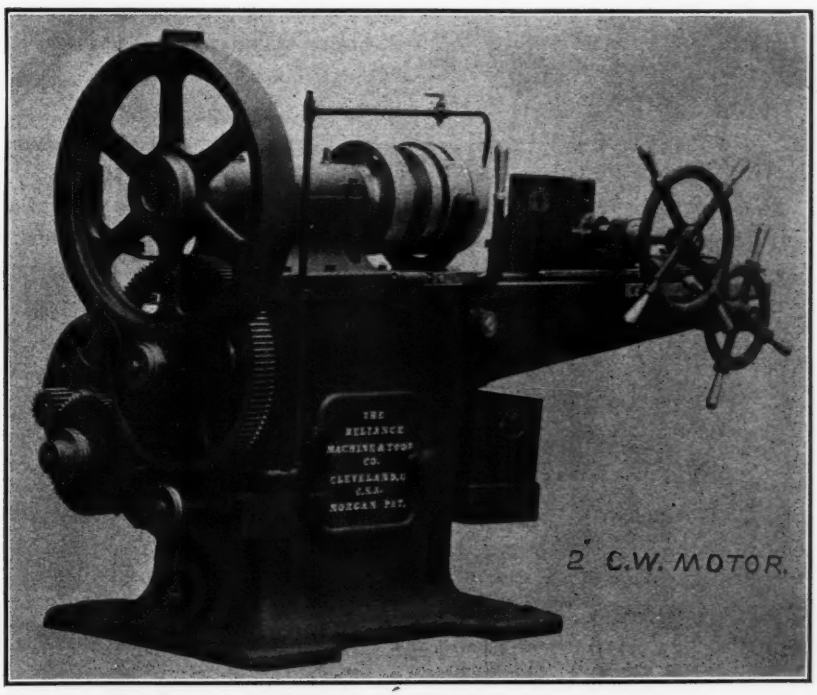


FIG. 2.—TWO-INCH BOLT CUTTER, EQUIPPED WITH VARIABLE SPEED ELECTRIC MOTOR.

Paper-Insulated Cables.

The life of paper-insulated cables is generally considered to be longer than those having rubber insulation. This consideration, however, may be changed by the character of the ingredients composing the rubber compound. It is stated that the dielectric strength to resist high voltages becomes greater with increasing proportions of pure Para or other high-grade rubber, and with lead-covered cables increasing the percentage of high grade rubber lengthens the life of such cables. The paper for paper-insulated cables must be very carefully selected and impregnated with insulating compound. An oily compound is best, as it permits the cable being handled without injury, and it also has the power of resisting high voltages better. The oily compound, however, gives the cable a low insulation resistance. Specifications, therefore, which aim to secure a good cable by requiring a high insulation resistance miss the mark in excluding the oily compound impregnated paper insulation and securing an inferior style of cable.

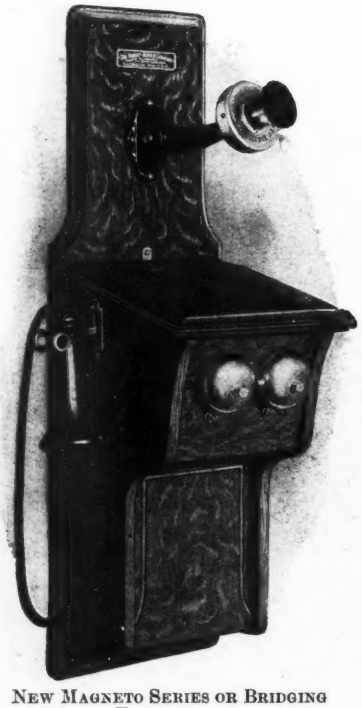
New Magneto Series or Bridging Telephone.

The Vought-Berger Company, of La Crosse, Wis., has placed on the market a new magneto telephone, for series or bridging systems. The accompanying illustration shows the wall set, enclosed.

The instrument is equipped as follows: Bell type solid back, long-distance transmitter mounted on hollow adjustable arm with double concealed cord. Bipolar receiver, concealed cord connections. Silk-wound long-distance induction coil. Long lever switch hook. Ringing circuit thoroughly well installed. Equipped with either three or four-bar series generator, or four or five-bar bridging generator. All binding-posts concealed. No bare wires used. Ringer striker is protected by nickel-plated guard. Combined saw-toothed plate and carbon block lightning arresters. Columbia dry batteries.

The transmitter arm is mounted on solid backboard, preventing bell reverberations. Looped hinging of flexible transmitter cord is done away with.

A swing-down shelf makes ringers readily accessible for inspection and adjustment—both gong-side and coil-side can be viewed simultaneously. Generator springs are easily reached. All working



New Magneto Series or Bridging Telephone.

parts can be inspected both from the front and the top.

Batteries are placed in compartment in lower portion of cabinet, and are covered by sliding panel. They can be reached without opening balance of telephone.

When the telephone is closed, the shelf is screwed firmly to backboard, obviating the necessity of a lock, and, at the same time, effectually protecting telephone from meddlers.

The backboard is kept from coming into close contact with wall, by small wooden bushings, which are inserted in back at points where wall screws go through.

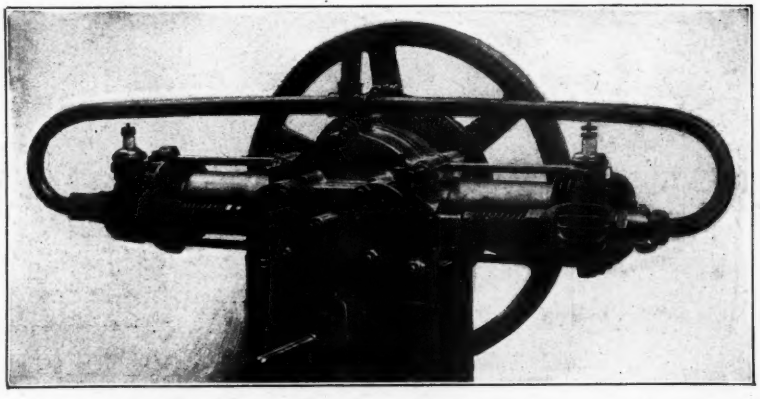
It is but a simple matter to change this telephone from series magneto to bridging, or *vice versa,* as cabinet will fit either generator.

This instrument is designated as No. 45 and is made up in either walnut or quarter-sawed oak. The Vought-Berger Company manufactures its own woodwork, and special attention is paid to finish.

A Light-Weight Motor.

The problem of aerial navigation has brought about many endeavors to obtain motive power with extreme light weight, and this has resolved itself into the question of how light can a motor be built consistent with strength of parts necessary to stand the energy exerted to be practical for the purpose of propelling a resistant body through space. The illustration herewith shows a gasoline motor, constructed by the Walters Power Company, 62-66 Van Winkle avenue, Jersey City, N. J., on an order for parties in St. Louis, Mo., as an experimental machine, to be supplemented later by a larger horse-power motor for practical use and proportionally as light in weight.

The motor is of the four-cycle, two-cylinder, opposed crank type, having a flywheel external of the crank case. The periphery of the flywheel is beveled and receives a clutch fastened to a scored pulley, seen in the rear of the illustration. This pulley is connected by a belt to a smaller pulley on the propeller shaft of the aeroplane. As this is only to be used on an experimental machine, a small device has been added, having a small cord leading from it, which releases the hold of this clutch and stops the action of the motor upon the propeller, when it is desired to stop it and let it descend. The spark shifter is shown in the front of the illustration and permits a variation of the motor speed.



A Light-Weight Motor for Aeroplane Driving.

The motor with flywheel and spark plugs weighs but twenty-four and a quarter pounds, by adding the carbureter and friction clutch its total weight is thirty-two and a half pounds. It was fully run upon the testing block for part of a day and a brake test applied showing an efficiency of two and three-tenths horse-power. This design of motor lends itself to lighter weight than the vertical motor of the same size. The material used in this machine is the best obtainable, respective to each part. Aluminum was used wherever permissible, owing to its light weight, with the above result. The manufacturers of this motor claim that they can produce a larger motor at even lighter weight per horse-power than the one here shown.

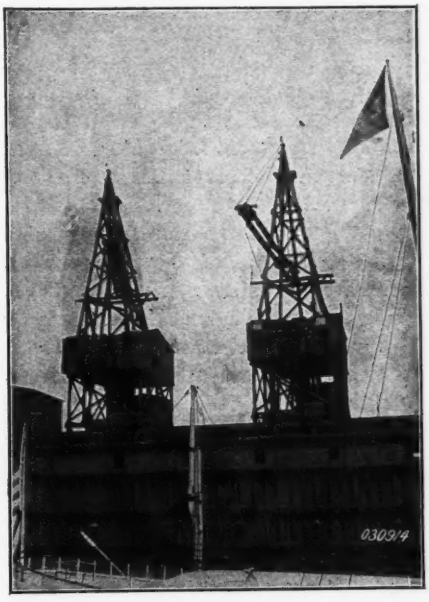
The Manhattan Railway Company, of New York city, has 120 miles of three-phase underground cable operating at a pressure of 11,000 volts. The test employed to detect any fault is to apply a pressure of 22,000 volts for a thirty-minute period. Several breakdowns have occurred during the past year, and these, it is thought, have not been due to faults in the insulation, but to faults in the lead sheath of the cable caused by stray currents from other properties passing along this sheath as a conductor. To prevent these troubles it has been decided to thoroughly insulate the lead sheaths of the cables in all the manholes, the portions of the cables in the conduits being already insulated by the conduits themselves.

A World's Record in Coal Hoisting.

The steadily increasing bulk in which coal is conveyed by sea and rail, and stored for boiler service in high pockets at power stations and plants, has led to a demand for increased speed in the necessary hoisting and handling machinery.

Demurrage on steamships and cars is an item to be carefully avoided in economical management, and the large cargoes now shipped to terminals can only be handled with success by specially designed high-speed machinery. The problem is different from, and more difficult than, the familiar one of bulk unloading and storage of coal, ore, or similar materials on the ground level from vessels. The element of height materially affects the machinery design. With a single tower, hoisting to about fifty feet above tide water, forty to sixty tons an hour was, until recently, the common speed, and ninety to one hundred tons was only attained with difficulty in exceptionally favorable circumstances.

The work demanded of coal-hoisting towers and their machinery is of the hardest description, both from the unskilled nature of the labor employed, and the shocks to the machinery incidental to the service, and it changes constantly with the nature and size of the coal, which may vary from a soft pea variety contained in open wooden barges to a hard foreign product in cubes, two feet square, loaded in steel vessels with small hatches. A great advance in the speed of handling coal from freight vessels and barges calls to be recorded a world's record for rapid unloading which has been recently established by the C. W. Hunt Company, West New Brighton, N. Y., at the Lincoln wharf power station of the Boston Elevated Railway.



COAL-HOISTING APPARATUS AT LINCOLN POWER STATION, BOSTON, MASS., ELEVATED RAILWAY COMPANY.

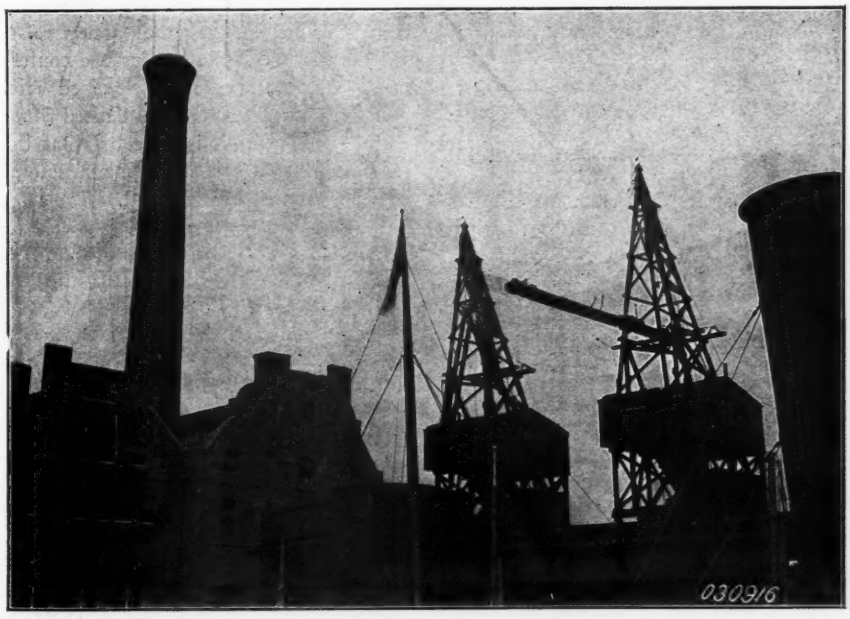
Run of mine bituminous coal was raised ninety feet above the tide water from one hatch of a vessel and delivered to the storage pockets, cracked to mechanical stoking size, at the rate of 320 tons per hour, by one tower. This is an advance of about 200 per cent upon the previous best, and marks an important mechanical engineering achievement.

To attain this end, the steam engines of fifty to one hundred combined horse-power, in common use, have been replaced by machinery of 300 horse-power, and the coal-cracking machine attached to the tower cracks to the proper dimensions for automatic stokers before passing to the pocket the enormous quantity of coal, over five tons per minute, delivered to it from the hoisting machinery. The ordinary small steam shovel has been supplanted by an automatic one of two tons capacity at each lift.

The time occupied in raising two tons of coal from the hold of a vessel to the discharging hopper, nearly 100 feet above, is only six seconds, while the round trip, involving the operations of lowering and moving the shovel out of the boom, opening the former, digging up two tons of coal, raising it to the level of the hopper and discharging it therein, is frequently performed in twenty-two seconds.

The installation, shown in the illustration, follows in general design, but in heavier proportion, the standard Hunt steeple tower rig, the moving gear and coal cracker being electrically driven and the hoisting engine direct-connected. The towers have to traverse overhead the whole length of the coal storage pocket and to move thirty feet at a time without changing steam connection. In this way a single tower can operate on each hatch of a vessel in turn, or several towers can work simultaneously.

The boom, made to fold up, for the free manipulation of vessels with their rigging, has an overhang of forty feet, and enables the tower to operate on coal steamers of the widest beam and largest dimensions.



COAL-HANDLING APPARATUS AT WHARF OF LINCOLN POWER STATION OF THE BOSTON, MASS., ELEVATED RAILWAY COMPANY.

New Type Battery Telephone.

J. H. Bunnell & Company, 20 Park place, New York city, have designed a new type of battery telephone which is designated as the "Beeko-Phone." This instrument is equipped with a solid-back transmitter, double-pole receiver, vibrating bell and call-button, and the apparatus is guaranteed by the company to give satisfaction on all short lines. The instrument makes a handsome appearance and is well constructed throughout, it being designed with such simplicity that any one can set it up. Copper wire is recommended for the lines.

NEW TYPE BATTERY TELEPHONE.

The instruments are very low in cost, and as they are intended for short-line intercommunication the equipment is very inexpensive.

The American Electrotherapeutic Association.

The American Electrotherapeutic Association opened its thirteenth annual convention in the marine parlor of the Hotel Windsor, on September 22. The delegates were welcomed by Mayor Franklin P. Stoy, who expressed the hope that the physicians would have a very pleasant time while meeting in Atlantic City, but, at the same time, he hoped that they would not have any opportunity to use any of their professional knowledge while in the city. Dr. Dickson, of Toronto, Canada, responded to the Mayor's welcome. Dr. B. C. Pennington welcomed the delegates on behalf of the local Academy of Medicine, and Dr. William James Herdman, of Ann Arbor, Mich., responded.

After the meeting had been called to order by Dr. Brower, the president, reports of the various committees were received and several honorary members were elected. The executive session was held from nine to ten o'clock, after which the scientific session was held. Resolutions of respect were adopted upon the death of Dr. Robert Newman, of New York city. Dr. Newman was to have read a paper on "Retrospect of the Second International Congress of Electrotherapeutics at Berne."

After the reading of a number of scientific papers, all of which treated of the use of electricity in various diseases, the members witnessed a special drill of the United States Life Saving Corps, after which the business of the afternoon session was taken up, when several other papers upon the use of electricity in the practice of medicine were read and discussed.

The entire morning of the second day's session was taken up with a discussion of the problems which arise in electrotherapeutic practice. At ten o'clock a number of the physicians made a visit to the United States Signal Station and inspected these quarters.

One of the most interesting papers of the afternoon session was that read by Dr. Margaret Abigail Cleaves, of New York city, which treated upon radium. This detailed exhaustively the use of radium rays in the treatment of cancer. Dr. Cleaves had a small phial which was exhibited. This was about an inch in length and as large around as the lead in a drafting pencil. This was viewed with great interest.

Following the reading of the resolutions of respect upon the death of Dr. Newman, reported by a committee composed of Dr. G. Betton Massey, chairman, and Drs. Charles R. Dickson and Frederick H. Morse, the officers for the ensuing year were chosen. The report of the nominating committee was received and adopted, and the secretary cast the ballot which named the following executives for the next fiscal year:

President, Dr. A. I. Rockwell, of New York; Vice-presidents—First vice-president, Dr. Willis P. Spring, of Minneapolis, Minn.; second vice-president, Dr. William W. Eaton, of Danvers, Mass.; treasurer, Dr. Richard J. Nunn, of Savannah, Ga.; secretary, Dr. Clarence Edward Skinner, of New Haven, Ct. Executive committee: Dr. Francis B. Bishop, of Washington, D. C., one year (to complete the term of Dr. Robert Newman, deceased); Dr. Daniel R. Brower, Chicago, Ill., three years; Dr. Maurice F. Pilgrim, New York, N. Y., three years.

There were several places suggested in which to hold the next meeting of the association, and the nominating committee did not make any recommendation. St. Louis was mentioned as one of the places, however, and that city received the unanimous vote of the association as the site for its next session.

The business meeting was short and following that a reception was tendered the members of the association and their wives by the profession of Atlantic County and the Atlantic City Academy of Medicine in the marine room of the Windsor.

Vacuum-Drying and Evaporating Apparatus.

The Emil Passburg vacuum-drying and evaporating apparatus is represented in the United States and Canada for manufacture and sale under the Passburg patents by Mr. Joseph P. Devine, 312 Mooney-Brisbane Building, Buffalo, N.Y. Mr. Devine is well known throughout the electrical field through his connection as vice-president of the National Battery Company, Buffalo, N. Y.

Mr. Emil Passburg, of Berlin, Germany, is a well-known authority on the subject of vacuum-drying and evaporating apparatus, and the Passburg system of drying and impregnating for dynamo and motor armatures, electric cables, field and transformer coils, etc., is used extensively in Europe by a number of the most representative companies.

It is claimed that this system will dry out absolutely all the moisture in armature and field coils. In fact, this system has its ramifications bearing in almost every industry where a rapid drying process is necessary.

The American Telegraphers' Tournament Association.

The American Telegraphers' Tournament Association will hold a tournament on October 30 and 31 in the auditorium of the National Export Exposition Buildings, Philadelphia, Pa. The primary feature of the tournament will be the speed contests in different branches of telegraphy. The most important event is the speed contest for the best "all-around" telegrapher in the world, for which Mr. Andrew Carnegie presented a handsome gold medal studded with diamonds, to be competed for annually. The medal was won last year by Mr. F. M. McClintic, of Dallas, Tex., who attained the record-breaking speed of sending 517 words in ten minutes and receiving on a typewriter 500 words in the same time. Other prizes will be awarded for speed by railway operators, broker operators, women operators, the "Old Timers" and a championship class. The "Old Timers" event is for operators over sixty years of age.

Through the courtesy of the Commercial Cable Company a siphon recorder—the instrument used on the Atlantic and Pacific cables—will be connected and an exemplification given of its workings. Wireless telegraphy will be one of the attractions which will be not only interesting, but instructive.

The expenses of the tournament have been raised by the Philadelphia operators, and no profit will accrue to the association, inasmuch as all the money raised will be devoted to prizes for the contestants. Entries are being received from operators in all parts of the United States and Canada, and it is expected that this tournament will surpass in magnitude all previous affairs of the kind.

A Possible Method of Reducing the Time of Exposure in Making X-Light Photographs.

To the Editor of the Electrical Review:

Recently in California a new variety of spodumene has been found and named Kunzite. Dr. Kunz and Professor Baskerville have found the mineral, after exposure to X-light, retains energy which it gives out for several minutes in the form of very short ether waves (phosphorescence). If in a finely divided form the spodumene retains this property it will be very valuable for use in the form of screens or mixed with the photographic emulsion for use in taking instantaneous photographs by X-light, as the action on the plate from the X-light would be carried on afterward by the spodumene.

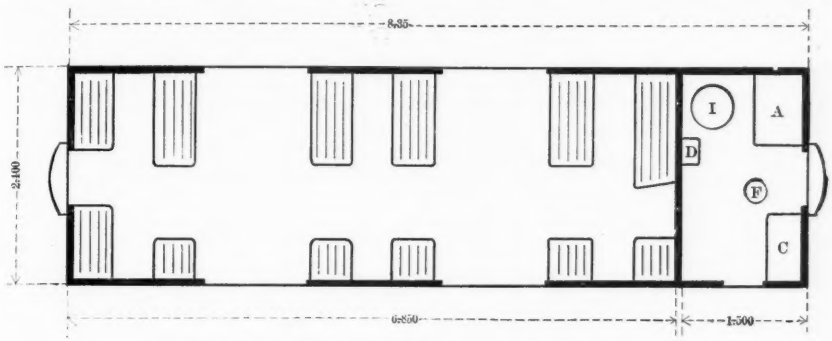
William Rollins.

Boston, Mass., September 25.

NEW FIREPROOF CAR FOR THE PARIS METROPOLITAN.

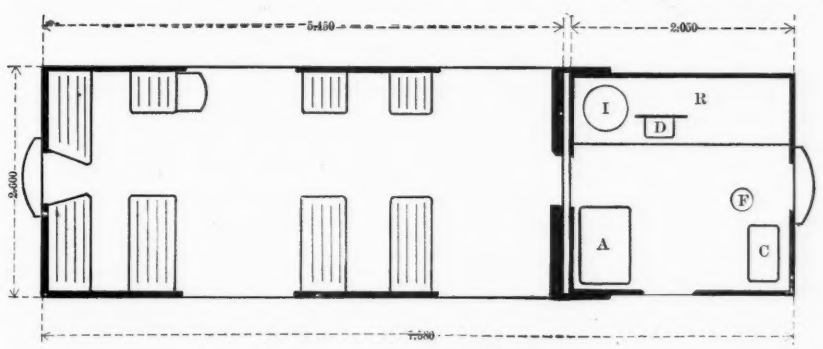
BY C. L. DURAND.

After the recent disaster on the Paris Metropolitan the city authorities had a consultation with the engineers of the road as to what would be the best measures to take in order to avoid such accidents in the future. One of the first improvements will be to make the cars as nearly fireproof as possible as they are now built of pitchpine which, while it is of ornamental appearance, is highly inflammable and as was proved in the present disaster a spark or a heating up of the wires can easily set fire to a car, and the whole train is soon in flames. The cars are already provided with fusible plugs and automatic circuit-breakers so as to cut off the current and avoid the possibility of the overheating of the wires, which would set fire to the woodwork. But as these may fail to work in spite of all the precautions, the wires are liable to become red-hot and thus cause great danger. It thus becomes necessary to make all the parts of the car, and especially those portions lying near the circuits, as nearly fireproof as possible.



THE OLD STYLE CAR ON THE PARIS METROPOLITAN.

With this end in view the Metropolitan Company has been studying a new type of fireproof car which will no doubt replace the present car. The form which was finally adopted by the company is shown in the diagram, and alongside of it is the plan of the old car, so as to show the improvement which has been made. Above is the present car, while the new design is shown below. In the new car the body will be made entirely of incombustible material; it will be built of metal and fibro-cement or sheet asbestos. Besides, as will be observed, the motorman's cab, which is seen on the right of the diagram, is now made considerably larger and is separated from the main body of the car by two fireproof partitions with an air-space between them. As the size of the cab is now increased, it gives room for installing the resistances of the motors. These resistances were formerly placed underneath the car, but in this case it will be easier to keep them in order and inspect them, thus avoiding another source of trouble. Besides, as the resistances are now placed much nearer the controlling apparatus, this suppresses a considerable quantity of the cables which were placed underneath the floor and were exposed to wear and consequent short-circuits.



THE NEW CAR ON THE PARIS METROPOLITAN.

The new car is considerably shorter than the old type, so as to shorten up the distance between the axles and allow the car to pass more easily around the sharp curves which are quite numerous on the Metropolitan road.

These projects have been submitted to the city authorities who will no doubt approve them at once and take measures to have the new cars substituted for the old form as soon as possible. In such case a short-circuit will no longer offer any danger to the train, as there will be no combustible material to be attacked. The position of the various controlling apparatus in the cab is indicated in the diagram; the same letters apply to the old and the new car.

At A is the air compressor, C the controller, D the automatic circuit-breaker, F the brake handle, I the reversing switch. The resistances are now placed in a large case R, which will be well ventilated.

Artificial Niagara at St. Louis.

An immense artificial cascade has been determined upon by the authorities of the Louisiana Purchase Exposition as the centrepiece of the semi-circular layout of the principal buildings. The cascade itself will be divided into three parts; a large middle cascade with a smaller one at each side, the water flowing directly into the head of the grand basin. In all, about 90,000 gallons of water per minute will be supplied at a head of 159 feet, forming the greatest artificial water effect ever attempted.

The water will be taken from the grand basin itself and will be raised to the top of the cascade by a pumping station located under Festival Hall. The pumping machinery will consist of three thirty-six-inch single-stage, turbine centrifugal pumps purchased from Henry R. Worthington, of New York city, each driven by a 2,000-horse-power Westinghouse alternating-current motor. The total horsepower utilized will thus be 6,000, making this the largest electric pumping station in the world. The pumps and other pieces of machinery for this plant are now being installed at St. Louis.

The new marine barracks at the Naval Academy, Annapolis, are to be lighted by electricity, generated by a motor-generator set, consisting of a 100-horsepower, direct-current motor mounted on the same bed-plate with and direct-connected to a sixty-kilowatt, two-phase alternator. The current will be generated at 1,100 volts and transmitted across the river and there transformed to 440 volts. These machines have recently been ordered from the Westinghouse Electric and Manufacturing Company, together with the usual switchboard and auxiliary apparatus.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

A CUBAN MUNICIPAL LIGHTING PLANT—The municipality of Cienfuegos is about to install a plant for the purpose of electrically lighting that Cuban city.

MILWAUKEE, WIS., TROLLEY PLANS—The Milwaukee Electric Railway and Light Company, one of the subcompanies of the North American Company, is projecting improvements which will cost millions. The work of the $600,000 central station will be pushed to completion, and in addition the company will erect stations at each corner of the city and will build a belt line from the lake shore on the northeast side to the lake on the southeast. The belt line will tap all of the suburban lines and connect with each line from the centre of the city. Viaducts will be built over the Kinnickinnic, Menominie and Milwaukee rivers. In addition to these improvements, work will be rushed on three interurban roads. A line to Port Washington, forty miles north, to connect with lines under construction from that point ninety miles beyond to Green Bay, will be rushed. This line will also by side lines tap Fon du lac and Oshkosh, thirty miles from the through line. Extensions of the suburban system fifteen miles to Oconomowoc and ten miles to Muskeo lakes are also projected.

A TELEPHONE COMBINATION—General Manager Webb, of the Maryland Telephone and Telegraph Company, in announcing the conclusion of a traffic agreement with the United Telephone and Telegraph Company of Pennsylvania, says: "Under the agreement the Maryland company gets a connection with Hagerstown, Md.; Winchester, Va.; Chambersburg, Carlisle, and Harrisburg, Pa., and many other places through a large territory." The Pittsburg and Allegheny Telephone Company, in which the Maryland company is largely interested, and the Johnstown Telephone Company have nearly completed a line between Johnstown and Pittsburg, while the United company is building a fourteen-mile line into Johnstown. When this work is finished the Maryland's service will be extended to Johnstown and Pittsburg, and will open up the western territory in Pennsylvania and into Ohio, Illinois and Michigan, where the Pittsburg & Allegheny company has lines in operation. The United States Long-Distance Telephone Company has just built a line into Cincinnati, and the Maryland will connect with it through the Pittsburg and Allegheny.

MANILA, P. I., POWER PLANTS—Governor Taft has cabled the War Department details of the franchise which is to be granted for furnishing power for various enterprises in Manila and elsewhere. He says the commission has surveyed the territory embracing Botocan falls at Mahihi, Province of Maguna, and Lamot and Caliraya rivers, near by, and that it has been discovered that at least 10,000 horse-power may be developed from these sources. The distance from Manila to the point in question is fifty-five miles, and Governor Taft says few engineering difficulties will be encountered. The local electric lighting company of Manila, backed by strong capital, desires to develop the power of the Angat river in Bulucan, a distance of thirty-five miles. The Philippine Government, however, should it decide to grant the franchise for furnishing power from this point, will give it to the highest bidder. The franchise will provide for the sale of power to all alike on reasonable terms fixed with reference to the cost of the plant. An opportunity probably will be given American investors to bid on the franchise, which Governor Taft states will be most valuable.

TELEGRAPH COMPANIES' EARNINGS—Stockholders of the Mexican Telegraph Company have received notices informing them of the declaration of the usual quarterly dividend of two and a half per cent and a statement and estimate of earnings for the quarter ending September 30. The statement shows an estimated surplus, after paying the October dividend, of $1,354,382. The estimated net earnings for the quarter are $94,000, not including interest on investments and deposits. This is the seventy-ninth dividend on the stock of the Mexican Telegraph Company. From the same office the report of earnings of the Central & South American Telegraph Company is sent out. President James A. Scrymser, who is also president of the Mexican Telegraph Company, calls attention to the fact that after the usual quarterly dividend of one and a half per cent is paid, there will be added $35,816 to the surplus fund. Mr. Scrymser adds: "In this company's report dated May 6, 1902, the views of experts on the limited possibilities of wireless telegraphy were published. Since that time nothing has occurred to change the views then expressed, and experts still hold to the opinion that wireless telegraphy can not rival submarine telegraphy for commercial purposes."

ILLINOIS INTERURBAN LINE—The contract for the building of the Dixon, Rock Falls & Southwestern Electric railway has been let, and it is expected to have the road entirely built and ready for business by September 1, 1904. The road, starting at Dixon, Ill., will pass through Nelson township and Rock Falls, thence southwest, striking Tampico, Hooppole, Atkinson and Geneseo. Several extensions are contemplated for the road and the main line will be a connection from Geneseo to Rock Island, a distance of twenty-three miles. Several towns, ten to twenty miles from the main line, are petitioning the officers of the company to build spurs of the road connecting with their towns. The Dixon, Rock Falls & Southwestern Electric Railroad Company was incorporated March 21, 1903. Over three-fourths of the right of way has been secured and the franchises have been obtained wherever the road is to go. The road, as far as the main line goes, will be sixty miles in length and will cost $1,500,000. A large share of this money will be spent in Rock Falls and vicinity in the erection of a large power-house and car barns. The main offices of the company will also be established in Rock Falls. The power-house and car barns will also be located there. The building of the road between Dixon and Rock Island will be the completion of a through line from Chicago to Rock Island, and when completed this road will be the shortest route between these two important points. It will do a large amount of business that other lines will not have the chance to do. The Northern Illinois road is being built to Dixon, and the Dixon, Rock Falls & Southwestern will connect it with Rock Island.

TELEPHONE AND TELEGRAPH.

CHATTANOOGA, TENN.—New machinery has been purchased in St. Louis for the electric plant at Ironton.

COLUMBUS, OHIO—The Tremont Home Telephone Company has increased its capital stock from $60,000 to $100,000.

ONAGA, KAN.—A franchise has been granted to R. G. Guffy and H. H. Benton for a second telephone exchange here.

HARRISBURG, PA.—The Pennsylvania Telephone Company has filed notice of an increase in its capital stock to $2,500,000.

LA CROSSE, WIS.—The village of Arcadia will install an electric light plant to be operated by the city, at a cost of about $6,000.

AKRON, OHIO—The Summit Rural Telephone Company has been incorporated to build a telephone line to Montrose, Ghent and Hammonds Corners.

CARROLLTON, GA.—The Gainesboro Long-Distance Telephone Company, of this city, has applied for permission to increase its capital stock to $150,000.

LIGHTSVILLE, OHIO—The Lightsville Telephone Company has been organized by David Minnich, J. L. Spring, E. Riegel, C. M. Ripp and D. P. Livingston.

POUGHKEEPSIE, N. Y.—It is announced that the New York State Telephone Company is about to begin work of stretching lines through Dutchess County.

CRAWFORDVILLE, IND.—The stockholders of the Waynetown Union Telephone Company, of Waynetown, have organized with W. S. Fowler as president.

NEWBURGH, N. Y.—The Highland Telephone Company is

about to construct a line from Little Britain to Coldenham through the Drury Lane neighborhood.

SOUTH LYONS, MICH.—The South Lyons Telephone Company has been organized with K. Calkins as president, and will build an independent telephone exchange here.

PORT CLINTON, OHIO—The new direct line of telephonic communication between Port Clinton and Toledo has been opened by the new Ottawa County Telephone Company.

HEMPSTEAD, L. I.—All the wires of the New York & New Jersey Telephone Company from the city line of Queens to Hempstead and to Babylon will be placed underground.

BANGOR, ME.—At a recent meeting of the Mungunsaw Telephone Company the following officers were elected: S. S. Thornton, president; Miles D. Arbo, vice-president; C. S. Newcomb, treasurer.

OLLIE, IOWA—The citizens have purchased the local telephone exchange from the Southeastern Iowa Telephone Company and reorganized under the name of the Ollie National Telephone Company.

KENTON, OHIO—The directors of the Citizens' Telephone Company, of Paris, Tex., have decided to erect a line to Honeygrove from Clarksville, and another from Sherman to Honeygrove.

KINGSTON, N. Y.—At a meeting of the Citizens' Standard Telephone Company, M. E. Drake was elected president; Jay E. Klock, vice-president; and Charles Reynolds, Jr., secretary and treasurer.

SCRANTON, PA.—The Wayne & Pike Independent Telephone Company elected the following directors at its annual meeting: B. F. Killam, H. W. Clark, Charles Killam, Ava Quick, D. Bingham, F. G. Hames.

POND CREEK, O. T.—A deal has been completed by which the Oklahoma & Kansas Telephone Company has purchased all the business, property and corporate rights of the Grant County Rural Telephone Company.

NORFOLK, VA.—The Southern Bell Telephone Company will erect a new exchange in this city which it is said will be one of the largest in the South, and will also make many improvements to its local service.

MILWAUKEE, WIS.—The Burlington, Rochester & Kansasville Telephone Company, of the town of Rochester, Racine County, has filed an amendment to its articles of incorporation increasing its capital stock from $2,500 to $5,000.

WILKESBARRE, PA.—The Bell Telephone Company is rebuilding its line from Berwick to Nanticoke. New poles will be erected and wires strung, and two additional pairs of wires will be added to accommodate the increasing business.

DAVENPORT, IOWA—On January 1 the general offices of the Iowa Telephone Company will be removed from Davenport to Des Moines, for the reason that the latter city is more centrally located in the company's field of operations.

LOS ANGELES, CAL.—Contracts have been let by the Kern River Company for a new power-house to be erected about forty miles from Caliente. The building will be a concrete and iron structure, 60 by 170 feet in size, with walls two feet in thickness.

BALTIMORE, MD.—The new exchange of the Maryland Telegraph and Telephone Company, at Forest Park, has been completed and placed in operation. The exchange cost $20,000 and will give much improved service to the people at Forest Park, Walbrook, West Arlington and the surrounding territory.

PORTERVILLE, WIS.—Work on the new brick substation for the Mount Whitney Power Company has been commenced by Manning & Sons, of Lemoore, who were awarded the contract for $2,340. It will be forty-two and one-half by twenty-six and one-half feet, wholly of brick, with concrete floor and corrugated iron roof.

WEST BROOKFIELD, MASS.—The Massachusetts Electric Light Company, of Palmer, which recently petitioned the selectmen for the right to erect poles and string wires in West Brookfield for the maintenance of electric lights in private residences in this vicinity, has been granted the privilege asked and will begin work at once.

McCONNELLSVILLE, OHIO—The Millgrove-Neelyville Telephone Company has been organized with the following officers: President, James Singree; vice-president, B. F. Wells; secretary, J. W. Harper; treasurer, A. M. McIntire. The survey for the line has been made and the company will erect the line from Millgrove to Neelyville very soon.

CADILLAC, MICH.—Messrs. Cornwell, Gaffney and Orr, who are planning to build an electric railway in this city, have secured an option on the property of the Cadillac Electric Light and Water Company, supposed to be valued at about $20,000. The option is good for thirty days. The syndicate is also securing options on all the desirable land in the vicinity of lakes Cadillac and Mitchell.

WASHINGTON, PA.—The Federal Telephone Company, which operates extensively in this section, is securing rights of way from Waynesburg by way of Graysville, Burdette and Burnsville, for a line to Dallas, W. Va., to meet a line already constructed from that place to Wheeling. The same company has completed a line from Waynesburg to Rutan, and with the proposed connecting link completed will have a thorough line ready for operation.

SODUS, N. Y.—The Empire State Telephone Company will enlarge and better its service in this section. For the benefit of Rochester, Williamson, Sodus and Wolcott patrons, a direct line of two copper wires is being installed. Williamson will be connected with Sodus Bay, and a series of wires will be run from Clyde to North Rose, and then west and south to Palmyra. Another line of wires will run to North Rose from Clyde and then east to Wolcott.

MINNEAPOLIS, MINN.—Both the Minnesota and Wisconsin companies owning power rights at the falls of the St. Croix have disposed of controlling interests to Stone & Webster and Lee, Higginson & Company, of Boston, for the Minneapolis General Electric Company, which is also controlled by Boston parties. The purchase price is given as $325,000 and the guaranty by the General Electric Company of the outstanding bonds of the St. Croix companies. Judge M. B. Koon, of this city, arranged the plan of purchase.

SPRINGFIELD, MASS.—The state board of gas and electric light commissioners has approved the petition of the Greenfield Electric Light and Power Company and authorized it to issue first mortgage twenty-year five per cent bonds to the amount of $100,000. With the money received from the sale of these bonds the company is to refund $25,000 of bonds outstanding and to pay the expense of developing the water power privilege recently obtained on the Deerfield river, near the Buckland and Shelburne line.

SALT LAKE CITY, UTAH—The contract for the construction of the proposed power plant for the Columbus Consolidated Mining Company has been let. Work is to begin at once and be completed by January 1 next. The plant, when completed, will represent an investment of about $40,000. It is proposed to generate sufficient electricity to drive the machinery of a mill to be erected later, and also for the machine drills in the mine. The company, in addition to this, expects to derive considerable revenue by furnishing lighting facilities for the citizens of the camp.

GRAND RAPIDS, MICH.—The Boyne City Electric Company has been organized in this city and articles of association have been forwarded to the secretary of state at Lansing. The company is capitalized at $10,000 and the following are the officers: President, E. A. Stowe; vice president, Henry Idema; secretary and treasurer, C. C. Follmer. The company will engage in lighting Boyne City by electricity. For a time a steam plant will be used and is to be located on land owned by President Stowe and Secretary-Treasurer Follmer. Later power will be secured from the Boyne river.

WESTFIELD, MASS.—Work has been commenced by Cosby & Gilmore, the contractors, on the new building that will form an addition to the Woronoco Street Railway Company's power-house. The company has been making preparations for this enlargement of its power facilities all summer, the building of the Holyoke line making it necessary. The contracts for machinery were let several weeks ago and it will be ready to install as soon as the building is finished. The addition will include a boiler room twenty-nine by forty-two feet in size and a condenser room twelve by nineteen feet. Machinery that will be powerful enough to care for any load the lines are likely to be called upon to carry will be put in place. The building is to be completed by November 1.

PERSONAL MENTION.

MR. W. W. BIRD has been appointed professor of mechanical engineering and director of the Washburn shops at Worcester Polytechnic Institute.

MR. JOHN RICE, sales manager of the Standard Electrical Manufacturing Company, Niles, Ohio, has been in New York city for the past week.

MR. HOWARD E. HUNTINGTON, formerly assistant general manager of the Pacific Electric Railway Company, of Los Angeles, Cal., has been appointed superintendent of electrical construction.

MR. S. D. CUSHING has been appointed signal and electrical engineer of the Southern Railway, with headquarters at Washington, D. C., in charge of electric block signals and electric power plant.

MR. CHARLES HENRY DAVIS, the well-known consulting engineer of New York city, was married on Wednesday, September 2, in the First Parish Church of Cambridge, Mass., to Miss Grace Bigelow.

MR. EUGENE H. ABADIE, the well-known electrical supply man, and vice-president of the Elblight Company of America, will be married on the evening of October 5, in St. Paul's Church, Louisville, Ky., to Miss Alice Bolling.

SIR DAVID BARBOUR, Lord Ribblesdale, George Gibb and Sir J. Dickson, members of the royal commission of London street traffic, which was appointed last July to study American street railway systems, recently sailed for New York.

MR. STEPHEN D. FIELD, of Stockbridge, Mass., the well-known electrical engineer, was a New York visitor this week. Mr. Field is at present engaged in a number of electrical experiments, and takes a deep interest in the developing field of wireless telegraphy.

MR. THOMAS D. LOCKWOOD, electrical engineer and patent expert of the American Bell Telephone Company, Boston, Mass., was a New York visitor during the present week, renewing numerous friendships in the metropolis and conferring with other electrical engineers in his field of work.

PROFESSOR H. T. PLUMB, a graduate of the University of Wisconsin, who for the past two years has been in charge of the electrical department of Pratt Institute, Brooklyn, N. Y., will take up the alternating-current work of Professor Matthews, at Purdue University, during the latter's year of absence.

MESSRS. JAMES O. CARR, J. S. Coles, E. J. Ryon and E. Reichtmyer composed the committee which welcomed the guests at the opening of the clubrooms of the Schenectady Railway Benefit Association, at the Fuller street station, Thursday evening, October 1. There was a reception and entertainment, followed by dancing.

MR. FRANCIS GRANGER has been appointed eastern sales manager for Mr. Leo Kaufman, of Pittsburg, Pa., manufacturer of coloring compounds as well as frosting for incandescent lamps. Mr. Granger is one of the most popular agents in New York city, and is already the sales manager for a number of high-class specialties.

MR. J. D. HOUSEMAN, JR., general manager of the St. Louis, St. Charles & Western Electric Railroad, of St. Louis, Mo., was presented, September 4, with a silver loving cup by the employés of the company. The presentation was made at a banquet given in celebration of the completion of the second anniversary of the road to the Missouri river.

MR. HUGH PATTISON has recently become associated with Westinghouse, Church, Kerr & Company, and is now engaged in engineering work in the office of the company's electrical engineer, Mr. O. S. Lyford. Mr. Pattison for some years past has been with Dr. Cary T. Hutchinson, and previous to that was actively identified with Mr. Frank J. Sprague in his multiple-unit work in Boston and Brooklyn.

MR. HUGH L. COOPER, chief engineer of the Mexican Light and Power Company, Limited, which concern is building a power plant at Necaxa for the generation of energy for transmission in the first instance to Mexico City, ninety miles distant, has left New York for Mexico. The initial capacity of the plant will be 45,000 horse-power. The turbine contract has been let abroad and it is expected that the generators will also be built in Europe. Nothing definite, however, has been decided upon.

MISS MARGARET E. MALTBY, Ph. D., who is a graduate of Barnard College, will be installed at the beginning of the academic year as adjunct professor of physics, at Columbia University, New York. Miss Maltby is also a graduate of Wellesley College and Oberlin College, and also worked in physics at the Massachusetts Institute of Technology at Boston. Miss Maltby was sent abroad as a fellow of the institute, and received the degree of Ph. D. at the University of Gottingen, Germany. This is the first time in the history of Columbia University that a woman has been appointed to a professorship.

MR. G. H. BARBOUR, of the De Forest Wireless Telegraph Company, has been in St. Louis completing arrangements for the installation of the World's Fair long-distance station, work on which will be begun in the course of a few weeks. This station will be located just east of the Agricultural Building. Mr. Barbour has just concluded negotiations which resulted in his securing the tower of the Electricity Building at Buffalo complete with its complement of elevators. The tower will be brought to St. Louis at once and the work of erection will be pushed. In the power-house at the base of this tower will be installed a ninety-kilowatt transformer, and with this amount of energy available, Mr. Barbour believes that messages will be transmittable to Chicago, Milwaukee and Buffalo.

NEW INCORPORATIONS.

COKATO, MINN.—Cokato Telephone Company. $10,000.

AUGUSTA, ME.—Boston Phœnix Lighting Company. $200,000. Directors: C. M. Drummond and W. G. Chapman.

CHICAGO, ILL.—Clinton Power Company. $50,000. Incorporators: Robert F. Pettibone, Frederick Pettibone and C. B. Swigart.

NEWHALL, IOWA—The Farmers and Merchants' Telephone Company. $1,600. Incorporators: James Harrington, F. G. Bryner.

PARIS, MO.—Monroe County Mutual Telephone Company. $4,500. Incorporators: W. Jones, W. S. Wiley, J. M. Grigsley and others.

BOSTON, MASS.—The Century Light Company of America. $500,000. Incorporators: Robert M. Bucknam, Harlem W. Leighton, Herbert R. Patee, Daniel S. Knowles and George E. Waring.

HARRISBURG, PA.—The Germantown & Chestnut Hill Belt Line Street Railway Company; to build twenty miles of road. The Johnstown, Woodvale Heights & Conemaugh Street Railway Company; $30,000. The Northern Street Railway Company; to build five miles of road in Beaver County; $30,000. The Washington & State Line Railroad Company; to build fifteen miles of road in Washington County; $150,000. The Dubois Southwestern Railroad Company; to build fifty miles of road through Jefferson, Indiana and Armstrong counties; $500,000. The Lancaster & Coatesville Street Railway Company; to build twenty-five miles of road, beginning at Mitmers Bridge, Lancaster County, and extending to Coatesville.

AUTOMOBILE NOTES.

ANNUAL RUN OF THE BUFFALO AUTOMOBILE CLUB—Buffalo Automobile Club, Buffalo, N. Y., on Saturday, September 19, held its third and greatest run of the season. There were eighty-four automobiles started, the run being from City Hall, Buffalo, to the International Hotel, Niagara Falls.

CALENDAR OF AUTOMOBILE DATES AND EVENTS—October 3—Race meet at Empire City Trotting Club, Yonkers, N. Y. October 5—Paris cab and delivery wagon trials. October 6 to 14—New York-Pittsburg endurance contest. October 10—Race meet of Automobile Club, of Philadelphia. October 31—Brighton Beach, New York, race meet. December 10 to 25—Paris automobile exhibition.

AUTOMOBILES AS FREIGHT CARRIERS—Professor John H. Gray, of Northwestern University, and Robert O. Vandercook, editor of an Evanston, Ill., newspaper, have gone on an extended trip through the wilds of Wyoming. While there they will investigate the possibility of establishing a line of freight automobiles in the region where no railroads exist, to take the place of the caravans now in operation.

ELECTRICAL SECURITIES.

There was increased activity in the market last week, but this was largely at the expense of values, and a number of prominent issues reached new low levels for the year. United States Steel securities which were anticipated by many to have reached the lowest posible figure the week before last, declined still further, and tractions were also on the list of securities which showed net declines of several points for the week. Brooklyn Rapid Transit was one of the principal sufferers, and while it closed strong at the end of the week there was still a noticeable lack of support.

The money market continues to grow firmer in tone, and last week rates made an appreciable advance. It is consoling at this time to realize that the government financiers are paying strict attention to the possibility of helping local options in case of severe monetary stringency. At the same time, the $40,000,000 fund which Secretary Shaw has in sight would not go a very great way in an extreme emergency; but it is very probable that such an amount would be only the initial help which the government is prepared to put forward if the necessity should arise.

The troubles of the Lake Superior Company, which is more popularly known as the Clergue industry, and which is very intimately connected with some of the large electrical developments at the "Soo," practically culminated last week through the company's inability to pay the $5,000,000 loan under which it has been laboring.

ELECTRICAL SECURITIES FOR THE WEEK ENDING SEPTEMBER 26.

New York:	*Closing.*
Brooklyn Rapid Transit	31¾
Consolidated Gas	168
General Electric	145
Kings County Electric	150
Manhattan Elevated	128¾
Metropolitan Street Railway	104¼
New York & New Jersey Telephone	140
Westinghouse Manufacturing Company	160

The directors of the Westinghouse Electric and Manufacturing Company have declared a quarterly dividend of 2½ per cent on the preferred and the assenting and the non-assenting stocks of the company. The dividend is payable October 10. Books close September 30 and reopen October 12.

Boston:	*Closing.*
American Telephone and Telegraph	125¾
Edison Electric Illuminating	230
Massachusetts Electric	77½
New England Telephone	124
Western Telephone and Telegraph preferred	80

The August instrument output of the American Telephone and Telegraph Company shows the smallest net output since November, 1900. The August net output was only 17,429, which compares with 15,796 in November, 1900, and with 72,220 in May, 1902, the latter being the largest in any single month. The total output since December 20 last was 407,430. The output and the number of instruments outstanding for the last five years are as follows: 1898, total outstanding, 1,124,846, an increase of 205,725, or 22.3 per cent; 1899, 1,580,101, an increase of 455,255, or 40.4 per cent; 1900, 1,952,412, an increase of 372,311, or 23.5 per cent; 1901, 2,525,606, an increase of 573,194, or 29.3 per cent; 1902, 3,150,320, an increase of 624,714, or 24.7 per cent. The increase in the eight months of 1903 was 12.9 per cent, as compared with 17 per cent in the same eight months of 1902.

It is officially stated that the gross earnings of the subcompanies of the Massachusetts Electric Companies will show an increase for the month of September of between $70,000 and $75,000. It is also estimated that for the year ending September 30 the gross earnings of the Massachusetts Electric Companies will show an increase over last year of about $350,000, but net earnings are not likely to show any increase by reason of the heavy increase in the cost of labor, fuel and other supplies. The subcompanies will, however, show a surplus above dividends paid to the Massachusetts Electric Companies, and the latter will show a surplus above fixed charges and preferred stock dividend requirements.

Philadelphia:	*Closing.*
Electric Company of America	7 15/16
Electric Storage Battery common	52
Electric Storage Battery preferred	52
Philadelphia Electric	5 15/16
Union Traction	43⅝
United Gas Improvement	81¾

Chicago:	*Closing.*
Chicago Telephone	117
Chicago Edison Light	145
Metropolitan Elevated preferred	54
National Carbon common	18
National Carbon preferred	88½
Union Traction common	4½
Union Traction preferred	30

ELECTRIC RAILWAYS.

WINONA RAILWAY AND LIGHT COMPANY, Winona, Ind., has started rebuilding its power plant at a cost of $100,000.

ATLANTA, GA.—The Atlanta & Marietta Electric Railway has applied to the county board for a franchise to build an electric line about twenty-five miles long.

GENESEO, ILL.—The Kewanee, Cambridge & Geneseo Electric Railway has been granted a fifty-year franchise. During the life of the franchise the company must light and pave the streets it occupies.

FORT SMITH, ARK.—President S. A. Williams, of the Sebastian Electrical Company, announces that his company will soon build an electric interurban railway fifty miles long to connect with the coal-mine towns of Sebastian County.

BOSTON, MASS.—Plans are said to have been completed for a through trolley line from New York to Boston. The line is to be by way of Worcester, Hartford and New Haven, and it is proposed to have through service between the two cities.

THE EXCELSIOR SPRINGS & MISSOURI STREET RAILWAY COMPANY has been granted a certificate of incorporation. The new company is capitalized at $200,000 and purposes to build a standard gauge electric railway from Excelsior Springs to Missouri City.

MEMPHIS, TENN.—It is reported that rights of way are being acquired by the Southern Kentucky Interurban Traction and Power Company for its proposed line from Russellville to Bowling Green and Hopkinsville. The line was recently incorporated by C. W. Courts, J. N. McCutcheon and others.

CLEVELAND, OHIO—The Westinghouse Electric and Manufacturing Company has commenced the erection at the Elyria power station of the Cleveland & Southwestern Traction Company of the two 1,000-kilowatt alternating-current Parsons turbine sets ordered some time ago. Three 500-horse-power boilers, a new switchboard and static transformers are to be installed.

SAN FRANCISCO, CAL.—Representatives of the Standard Oil Company purpose to build an electric railway to connect Point Richmond with West Berkeley. The franchise, for which application has been made, calls for a road from San Pablo *via* Richmond, Barrett Station and Steege to West Berkeley, where connections can be made with other steam and electric lines for San Francisco.

PHILADELPHIA, PA.—The Pennsylvania Railroad will test the practical value of a new system of electric signaling, and an arrangement has been made by the West Jersey & Seashore Railroad with the Leon W. Pullin Electric Company, by which the latter will equip with its wireless, broken-current system the section of West Jersey tracks at Atlantic City, from the drawbridge to Chelsea, about a mile.

GENERAL TRACTION COMPANY, Camden, N. J., has filed articles of incorporation in the county clerk's office with a capital stock of $1,000,000, of which $26,000 is said to be paid in, is formed for the purpose of building an operating trolley line between Camden and seashore resorts. One of the lines, it is said, will run to Atlantic City and another to Cape May, passing through other resorts along the South Jersey coast.

LITTLE ROCK, ARK.—The Sebastian County Electric Company, of Fort Smith, has filed articles of incorporation with the secretary of state. The incorporators are S. A. Williams, president; Wharton Cormall, secretary, and H. G. Bollinger, treasurer. The capital stock is $1,000,000. The purpose is to connect Fort Smith with Jenny Lind, Greenwood, Huntington, Mansfield and Hartford, all mining towns, and also to connect with branches to Montreal and Burma, for the purpose of furnishing these towns with light and power.

INDUSTRIAL ITEMS.

THE OTIS ELEVATOR COMPANY, New York, N. Y., is sending out a circular descriptive of its "New Type of Escalator," which will be sent upon request.

THE EMPIRE ELECTRIC SUPPLY COMPANY, 57 West Jackson Boulevard, Chicago, Ill., is receiving numerous enquiries for the "Chicago" incandescent lamp and the "Hamblin" 1903 arc lamp, and will be glad to quote special prices to any one interested.

THE FIDELITY ELECTRIC COMPANY has been organized with a capital of $50,000. This company is the reorganization of the George C. Towle Manufacturing Company, Lancaster, Pa., manufacturer of electric motors, generators, desk fans, ceiling fans. etc.

EDWARD S. HALSEY, Chicago, Ill., manufacturer of the Halsey direct-current integrating meter, will be pleased to send a new catalogue which has recently been published to any one interested. This catalogue describes and illustrates the Halsey meter, and shows several views of the assembly of the different parts of the meter.

THE UNITED STATES LIGHTING AND HEATING COMPANY, New York city, manufacturer of the "Moskowitz" system of train lighting from the axle, announces that it has had a complete equipment in operation on the New York Central flyer, the "Empire State Express," for the past six months, and that it has given constant and satisfactory service.

THE ELECTRICAL APPLIANCE COMPANY, Chicago, Ill., has just distributed two handsome catalogues, Nos. 19 and 20. No. 19 is the telephone catalogue and is very complete in everything pertaining to telephone work. No. 20 lists a complete general line of electrical supplies for electric lighting, street railway and other construction. Catalogues will be sent upon request, together with an up-to-date price list.

THE PEERLESS ELECTRIC COMPANY, Warren, Ohio, is distributing a unique folder entitled "100 Per Cent Overload." This describes in detail a test which has recently been made of two standard Peerless transformers, both 125-cycle 500-watt machines, one air-cooled and the other oil-cooled. The folder gives a description of the manner in which the tests were carried out and the results, which were highly satisfactory, and showed a very commendable rating for the Peerless apparatus.

THE BUFFALO STEAM PUMP COMPANY, Buffalo, N. Y., manufacturer of electric pumps and condensers, is distributing a new catalogue descriptive of its apparatus. This catalogue contains in compact form sufficient information to enable selections to be made of the type and size of pumps for ordinary or special service. The company will be pleased to receive communications with regard to special installations, and will also send on request a general catalogue or any special catalogue bearing on some particular design.

THE STANDARD VITRIFIED CONDUIT COMPANY, 39-41 Cortlandt street, New York city, announces that it has on hand a large stock of multiple and single-duct conduit in all sizes, and can make immediate shipments. Its factories are in full operation, producing over 80,000 duct feet of conduit per day. The Continental Trust Company, of the city of New York, has been appointed receiver for the Standard Vitrified Conduit Company pending certain settlements. All statements, however, are made over the signature of Mr. B. S. Barnard, president of the company.

ATWATER KENT MANUFACTURING WORKS, Philadelphia, Pa., is sending out an attractive circular descriptive of its "automatic volt-ammeter." This instrument is designed and calibrated especially for testing batteries in connection with gasoline automobiles and launches, and for any other use of like capacity. The needle is delicately pivoted and the readings are accurate. Flexible leads of ample capacity are provided with each instrument. No change is made in the connection to the battery for the two readings, as that in amperes is obtained by simply pressing the button.

ROSSITER, MacGOVERN & COMPANY, Incorporated, Whitehall Building, 17 Battery place, New York city, advise that they have ready for immediate delivery several pieces of Westinghouse and General Electric apparatus of the latest types. Although these have already been put in use, they are practically new. There are two direct-connected units, one a 200-horse-power alternating-current motor; several alternating-current motors, one of two-phase and several of three-phase type; a number of belted generators and a number of induction motors and transformers.

THE GOULD STORAGE BATTERY COMPANY, New York city, announces the following recent contracts: Lexington Street Railway, Lexington, Ky., 256 cells, with a capacity of 640 amperes, and an automatic regulating booster of the Gould type, to be installed with the battery; Easton Power Company, Easton, Pa., 255 cells, with a capacity of 960 amperes, also switchboard and regulating booster (this plant is the second installation made for this company); Northampton Power Company, Easton Pa., floating battery, with a maximum discharge of 360 amperes and 600 volts.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., manufacturer of the "chloride accumulator," has closed contracts with the New York Edison Company, and the Chicago Edison Company for additional batteries. These are in addition to the installation mentioned in a recent issue. The battery for the New York Edison Company consists of 150 cells with a capacity of 4,480 ampere-hours, and makes the twenty-third installation for this company. The battery for the Chicago Edison Company makes the fourteenth battery operated by this company, and has a capacity of 2,813 kilowatt-hours.

THE STURGESS GOVERNOR ENGINEERING COMPANY, West Troy, N. Y., is distributing a new edition of its catalogue descriptive of its specialties. This catalogue describes and illustrates turbine wheel governors, impulse wheel governors, variable speed power-transmission apparatus, and high-speed air pumps. Supplementing the matter descriptive of the apparatus manufactured by this company are several chapters detailing "Methods of Connecting Governors to Water-Wheel Gates," "The Size Governor Required for Different Power Water-Wheels," and "A Few Broad Principles Concerning the Speed Regulation of Water Power Plants."

HARVEY HUBBELL, Bridgeport, Ct., is distributing an attractive series of advertising circulars descriptive of the Hubbell improved screw slotter, which has a capacity of 30,000 brass or 15,000 iron screws per day; the Hubbel horizontal tapping machines, the Hubbell riveting machines, a price list of machine screws, a card showing screws for electric goods, cutlery goods, plumbers' goods, stove trimmings, piano hardware, bicycle fittings, and the Hubbell pull socket with lamp base attachment. This device can be attached to any ordinary key socket or receptacle without disturbing any part of the fixture already installed. The Hubbell universal attachment plug is particularly adapted for desk and table lamps, fans, surgical instruments and other light apparatus. The base screws in without twisting the cord, after which the cap, with the cord attached, may be inserted with a slight push. This plug can be separated with a straight pull.

THE AUTOMATIC ELECTRIC COMPANY, Chicago, Ill., is distributing a new edition of its splendid catalogue descriptive and illustrative of the automatic telephone system manufactured by this company. Desk telephones, wall telephones, pedestal telephones, calling devices and ringers and all parts of the assembly of its automatic instruments are carefully described in this catalogue. The first large telephone exchange in the world to adopt the automatic system was opened recently in Dayton, Ohio, by the Home Telephone Company. It is estimated that some 7,000 people passed through the building on the opening day, all of whom were given an opportunity to see the automatic exchange in operation. The Automatic Electric Company secured the contract some time ago for a complete central office equipment to take care of a present capacity of 6,000 subscribers, with an ultimate capacity of 19,000. This exchange is now complete and the telephones are rapidly being connected to the switchboard. It is stated that the subscribers are entirely satisfied with the precision and promptness with which the Automatic company's apparatus does the work. Smaller exchanges have been in operation for several years in Augusta, Ga.; Fall River and New Bedford, Mass.; Berlin, Germany; Auburn, N. Y., and a number of smaller towns. Dayton is the first city to install so large an equipment. An automatic switchboard of 10,000 stations and a capacity for 100,000 has been completed and is now being put into service at Chicago, Ill. There are a number of large cities, however, which are following the lead of Dayton and Chicago, and which have contracted for the equipment of the Automatic Electric Company. Among the orders secured by the company are the following: A 7,000-station exchange for Columbus, Ohio; a 5,000-station exchange for Grand Rapids, Mich.; a 2,500-station exchange for Portland, Me.; a 3,000-station exchange for Lincoln, Neb., and a 1,200-station exchange for Burlington, Iowa.